Determinants of leisure-time physical activity among early adolescents

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Abstract

Determinants of leisure-time physical activity among early adolescents

A physically active lifestyle is now recognised as an essential component of healthy living. As well as longer term health gains, physical activity during childhood promotes optimal growth and development, helps prevent overweight and obesity, protects against risk factors for cardiovascular disease and enhances psychological wellbeing. However, evidence suggests that many young people are not sufficiently active to benefit their health.

In order to inform the development of effective interventions, there is a need to understand the factors which influence physical activity participation among young people in Scotland. The aim of this study was to investigate modifiable determinants of physical activity among early adolescents during the period of transition from primary to secondary school. Drawing on a multidisciplinary perspective, within a socio-ecological framework, the relative influence of psychological, social and environmental factors was examined. Data were collected longitudinally as part of the Physical Activity in Scottish Schoolchildren (PASS) study. In total, 1099 children who completed a questionnaire in both Primary 7 (age 11 years) and Secondary 2 (age 13 years) were included.

The results show that boys were significantly more active, reported more favourable psychological profiles and had greater support from fathers and peers for being active, than girls. A range of psychological, social and environmental variables were significantly associated with physical activity, of which psychological factors accounted for the greatest proportion of variance in behaviour. Intention to be active was the most consistent predictor of physical activity across age and gender groups. Combined psycho-social-environmental models explained around two-fifths of the variance in physical activity among boys and around a third of the variance among girls. Physical activity participation in P7 was predictive of participation in S2, indicating that early involvement increases the likelihood that young people will continue to be active as they get older.

The results support the need for integrated, multifaceted approaches to physical activity promotion among the early adolescent population in Scotland, addressing influences at the individual and supra-individual level. Age and gender were moderators of physical activity behaviour, demonstrating the importance of understanding gender-specific determinants within a developmental context.

I confirm that this thesis has been composed by myself, that the work presented here is my own and that it has not been submitted for any other degree or professional qualification.

Joanna C. Inchley

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Preface

"Of all the causes which conspire to render the life of man short and miserable, none have greater influence than the want of proper exercise."
Dr William Buchan, 18th century Scottish physician

From a public health perspective, the promotion of physical activity is now a key priority. The evidence for a relationship between physical activity and health is well-established and yet many young people today are not active enough to benefit their health. Sharp declines in physical activity are observed during adolescence, particularly among girls. It has been estimated that, during the school years, daily physical activity decreases at a rate of 2.7% per year in males and 7.4% per year in females (Sallis, 1993). Consequently, the adolescent years have been identified as a critical period for physical activity promotion. Evidence that behavioural habits established during childhood and adolescence may continue into adulthood provides an important rationale for early intervention. Promoting positive physical activity experiences during childhood and adolescence is therefore essential for developing and reinforcing healthy patterns of behaviour.

In order to develop effective interventions to promote physical activity among children and adolescents, the factors which influence physical activity behaviour must be understood. Within a socio-ecological framework, it is recognised that a wide range of interpersonal, intrapersonal and environmental factors are important. While much work has been undertaken to identify correlates of physical activity among children and adolescents, most research in this area is cross-sectional in nature, thus preventing analysis of temporal change and causal pathways. Evidence from cross-sectional studies suggests that determinants of physical activity may vary developmentally, but there is a need for longitudinal cohort studies to confirm these findings. Furthermore, research on physical activity behaviour is often guided by specific disciplinary or theoretical perspectives. While much has been learnt from such studies, there is a need for multidisciplinary approaches in order to gain a more comprehensive understanding of young people's physical activity behaviour.

The core purpose of this thesis is to enhance understanding of physical activity within a Scottish context by identifying the key determinants of behaviour among the early adolescent population. The research utilises a longitudinal design to investigate a range of psychological, social and environmental influences on physical activity participation during young people's leisure time. Analyses are undertaken using data collected as part of the Physical Activity in Scottish Schoolchildren (PASS) study, a five year prospective cohort study tracking young people from the final year of primary school (P7) to the fourth year of secondary school (S4). The research presented in this thesis focuses specifically on the transition period as children move from primary to secondary school (P7 to S2) as this is the stage at which sharp declines in physical activity participation tend to occur, particularly among girls. For many young people, this period also coincides with the onset of puberty and thus represents a time of major physical change and psychosocial adjustment.

Within an overarching public health framework, the research draws on evidence from a range of disciplines including behavioural science, sport and exercise psychology, developmental psychology, environmental science and the sociology of sport. In covering such a breadth of perspectives, it is not possible to do full justice to any one field of study. Instead, by adopting an integrative approach, the study seeks to identify those factors of greatest relevance to the early adolescent population in order to guide the development of physical activity interventions among this age group.

The thesis is organised in six sections. In **Section 1: Introduction**, findings from a comprehensive literature review are presented. Chapter 1 first describes the approach taken to identify relevant literature and then provides an overview of the relationship between physical activity and health within the child and adolescent population and thus provides a rationale for the promotion of physical activity from a public health perspective. Chapter 2 describes trends in physical activity behaviour among children and young people, highlighting the evidence for declines in participation during early adolescence. Patterns of behaviour are considered in relation to age, gender, maturational status, socio-economic status and ethnicity. Key methodological considerations in the measurement of physical activity are also discussed. Chapter 3 provides an overview of the main health behaviour models and theories which have been applied to physical activity. In doing so, the aim is to identify the core elements of each which may be relevant to physical activity behaviour among children and adolescents in order to develop an integrative approach within a broader socio-ecological framework. Chapters 4 to 6 then examine the evidence for the role of specific categories of influence on physical activity behaviour. In doing so, these chapters provide guidance for the selection of variables to be included in the current study. Chapter 4 focuses on psychological factors, including both physical self-perceptions and attitudes towards physical activity. Chapter 5 considers the influence of social (interpersonal) factors, with particular reference to socialisation processes. Chapter 6 reviews the emerging evidence for the role of environmental factors in supporting and promoting physical activity behaviour. Chapter 7 provides background information on the wider context in which the research took place, including an overview of current policy of relevance to the promotion of physical activity among Scottish adolescents.

Section 2: Methods is arranged in five chapters. Chapter 8 describes the key aims of the study and research questions to be addressed. Chapter 9 focuses on research design, with a discussion of key methodological considerations and the research process. Chapter 10 describes the various physical activity measures which were included in the PASS study. Of these, the Physical Activity Questionnaire for Older Children (PAQ-C) measure was selected for use as the outcome variable in subsequent analyses. A full description of this scale is provided, and the issues which were taken into account in the selection process are also discussed. Chapter 11 provides details of the explanatory variables which are included in the study. Finally in this section, Chapter 12 describes the analytic strategy and statistical techniques employed.

Findings from the study are presented in **Section 3: Results**. Chapter 13 provides information about the study sample and discusses the issue of loss to follow-up which is common within longitudinal research. Chapter 14 presents trends in physical activity participation across the primary-secondary school transition drawing on the full range of physical activity measures included in the study. Physical activity patterns are shown by age, gender, socio-economic status and maturational status. Chapters 15 to 17 present separate models for the influences of psychological, social and environmental factors, respectively, on physical activity. To aid the reader, tables are colour-coded, with psychological data presented in blue, social data presented in red and environmental data presented in green. In Chapter 18, the results from the three separate models are combined into integrative psycho-socio-environmental models to consider the relative importance of these factors in relation to physical activity behaviour. Finally, in Chapter 19, results from longitudinal analyses are presented showing P7 predictors of S2 physical activity.

The final two chapters in **Section 4: Discussion and Conclusions** present a discussion of key findings, implications for practice and opportunities for future research. The main focus of this section is on those factors which are modifiable and relevant from the young person's perspective. Based on the results of the study, and drawing on the Youth Physical Activity Promotion Model (Welk, 1999) as a theoretical framework, a model of determinants of physical activity behaviour among early adolescents is presented. The relevance of the findings to the development of interventions within a range of settings is discussed.

All cited references are listed in **Section 5: References**, and appendices, including a copy of the questionnaire used in the study, are incorporated in **Section 6: Appendices**.

Section 1

INTRODUCTION

Chapter 1

Promoting physical activity: a public health perspective

"Public health experts now recognise the health-damaging mismatch between a human phenotype designed for regular physical activity and an environment that increasingly acts to minimise activity." (Sparling *et al.*, 2000, p.374)

1.1 Introduction

Promoting physical activity among the population as a whole has been called "*today's best buy in public health*" (Morris, 1994, p.807). There is strong evidence for a relationship between physical activity and health and, in particular, the protective role of physical activity in relation to many chronic diseases. This chapter presents an overview of this evidence and thus provides a rationale for the promotion of physical activity from a public health perspective, by highlighting the many health-related benefits of physical activity and, conversely, the health (and economic) consequences of inactivity. By far the majority of evidence has come from studies of adults, mainly because many of the relevant conditions do not occur until adulthood. However, the evidence base for health benefits among children and adolescents is growing and is the focus of this chapter. Reference to the adult literature will be made where there is a lack of data on children and adolescents.

Movement is integral to human survival. Throughout history, fundamental tasks such as the provision of food, water and shelter have been dependent on physical exertion. Today, however, life functions very differently. There have been dramatic changes in industrialised nations within just a few generations. Home and work settings are dominated by labour-saving devices. In addition, leisure-time experiences have been transformed with the advent of the technological age bringing increasing access to a wide range of sedentary activities via television, computer games and the Internet. As a result of such changes in the way we live, work and spend our leisure time, time spent in necessary physical activity has decreased and physical inactivity has consequently become a major public health challenge.

1.2 Strategic approach to identifying literature

A comprehensive literature review was undertaken to identify relevant literature in the following broad areas:

- Physical activity and health
- Young people and physical activity
- Correlates and determinants of physical activity
- Physical activity measurement

A search was undertaken of key databases including Web of Knowledge (SSCI and SCI), SPORTdiscus, Medline, PsycINFO, ERIC and Physical Education Index. A list of primary search terms used is shown in Box 1.1. The initial search was undertaken for the period 1981 to 2001 to allow for all relevant papers published within the last 20 years to be located. Searches were limited to human and English language only.

Box 1.1: List of search terms used in literature review	
physical activity	confidence
exercise	mental health
sport	motivation
determinants	self-concept
predictors	achievement
correlates	self-esteem
adolescen*	self-efficacy
child*	perceived competence
health	maturation
health promotion	pubert*
theory	behaviour / behavior
questionnaire	social / socio*
assessment	environment*
measurement	psycho*

Following the initial database search, regular online and hand searches were made of key journals in the field to ensure that all relevant papers that were published during the course of the period of study were located. Thus, a comprehensive review of all relevant literature published between 1981 and 2007 was undertaken. Furthermore, searches were made of the reference lists of significant papers in order to identify additional papers of interest.

1.3 Defining physical activity

Physical activity has been defined as "*any bodily movement produced by skeletal muscles that results in energy expenditure*" (Caspersen *et al.*, 1985, p.126). It is a multidimensional construct which includes frequency, duration, intensity and type. As such, it is classified as a (health) behaviour and distinct from physical fitness, which is a physical attribute relating to the ability to perform physical activity. Physical fitness has health-related components (such as cardiovascular fitness, muscular strength and endurance, flexibility and body composition) and performance-related components (such as agility, balance, coordination, power, reaction time and speed). While one might assume some degree of association between physical activity and physical fitness, studies have found only a weak or no relationship in children (Morrow & Freedson 1994; Janz *et al.*, 1992; Armstrong *et al.*, 1996). Although there is no clear evidence to suggest that children's fitness levels have decreased in recent years, research indicates that a large proportion of young people are inactive and sedentary activities are common (Armstrong & Welsman, 1997). There is general agreement that young people should participate in regular physical activity in order to improve health and well-being and reduce the risk of obesity. Therefore, from a public health perspective, a key aim is to encourage active lifestyles and lifelong participation by promoting physical activity from an early age.

Subcomponents of physical activity include exercise and sport. Exercise is typically described as volitional, planned, structured, repetitive and generally carried out in order to improve or maintain fitness and / or health. According to Cale & Harris

(2005), sport is a subcomponent of exercise defined by rules, structure and competition, and involving gross motor movement characterised by physical strategy, prowess and chance. While some reference will be made throughout this thesis to fitness, exercise and sport, the primary focus is on physical activity behaviour as a current public health priority.

Fox and Riddoch (2000) identify five dimensions of physical activity which are relevant to children's health and wellbeing:

- energy expenditure (for energy balance and weight regulation)
- moderate-to-vigorous physical activity (for cardiovascular health)
- weight-bearing activity (for skeletal health)
- resistance and endurance activity (for muscular strength)
- high-range movement (to increase flexibility).

Total energy expenditure is of great importance, particularly in relation to concerns over rising levels of obesity. In general, physical activity and movement account for 20% of total energy expenditure, with the remaining 80% being used for body metabolism. However, in terms of health improvement, the main emphasis is currently on promoting moderate-to-vigorous physical activity.

Different types of physical activity can be compared using metabolic equivalent (MET) values. MET values represent the average value of the energy cost of a specific activity for a population of subjects. One MET is considered to represent resting energy expenditure. Sallis and Owen (1999) define moderate activity as that which requires approximately three to six times as much energy as rest (3-6 METs) and is equivalent to brisk walking. Vigorous activity is defined as that which requires seven times as much energy as rest or greater (7+ METs) and is equivalent to jogging. However, the applicability of MET values may vary according to an individual's level of fitness (Howley, 2001) and body weight (Spadano *et al.,* 2003).

1.4 Physical activity and health

The US Surgeon General's Report on Physical Activity (US Department of Health and Human Services, 1996) was a seminal document drawing together the primary evidence for the relationship between physical activity and health, and highlighting areas for future development of policy and practice. Physical inactivity is thought to be the second highest cause of preventable mortality after smoking (McGinnis & Foege, 1993) and it is estimated that sedentary lifestyles account for a third of all deaths from major chronic diseases such as coronary heart disease (CHD), cancer and diabetes (Powell & Blair, 1994). Sedentary people have about twice the risk of developing or dying from CHD than active individuals (Press *et al.*, 2003) and a dose-response relationship between physical activity and CHD is evident (Batty & Lee, 2004). In the UK, the direct cost to the National Health Service of physical inactivity has been estimated at £1.06 billion per year (Allender *et al.*, 2007). A recent analysis of the economic benefits of a physical activity strategy for Scotland (Melly, 2002) estimated that a 5% reduction in the prevalence of inactivity over five years could lead to a 6.4% reduction in deaths attributable to inactivity, a reduction in hospital admissions and resultant saving to the NHS of around £3.5 million and a total economic gain of £85.2 million (based on £30k per life year gained).

While the relationship between physical activity and physical health is well established in adults, evidence for such a relationship in young people is weaker. It has been argued that, in developed countries, children's health is generally good and there is little evidence of detrimental health effects of inactive lifestyles (McManus, 2000). Indeed, Aaron *et al.* (1993, p.851) comment that, "*the promotion of physical activity in adolescents is based on the prevention and treatment of obesity, modification of risk factors for disease, and the development of an active lifestyle that may carry over into adulthood. However, there are few data to support these purported benefits of physical activity in adolescents.*"

A major problem in undertaking research in this field is that many of the chronic diseases which are associated with physical inactivity in adults do not typically appear among young people, for example, coronary heart disease, certain cancers and type II diabetes. Therefore, in studies of young people, risk factors for these diseases are commonly used as markers of future ill-health but most of the findings are weak and inconsistent. Cavill *et al.* (2001) offer a number of explanations for this which suggest that the absence of evidence may be due more to use of inappropriate risk factors or measurement error rather than absence of an effect. These are (a) the use of inappropriate definitions of physical activity, for example, sustained vigorous activity which is not commonly observed in young people, (b) lack of variance in physical activity and risk factors in young people because of higher overall levels of activity and fitness, (c) use of self-report measures which have limited validity, and (d) the potential impact of physical activity on underlying disease processes which are not included in commonly studied risk factors, for example, accumulation of atherosclerotic plaque.

Despite the lack of conclusive findings and the need for further research, the imperative to promote physical activity among children and adolescents is widely accepted. A body of evidence is developing which suggests a number of immediate health-related benefits from regular participation in physical activity as well as longer-term improvements in adult health status. According to a recent report from the British Heart Foundation (2004), direct health benefits from being active as a child include:

- healthy growth and development of the musculoskeletal and cardiorespiratory systems,
- maintenance of energy balance (in order to encourage a healthy weight),
- avoidance of risk factors for coronary heart disease, such as high blood pressure and abnormal lipid profile,
- opportunities for social interaction, achievement and mental wellbeing.

Furthermore, a range of longer-term benefits associated with future adult health status have also been identified, including:

- maintenance of optimal body weight in childhood, thus reducing the risk of obesity in adulthood,

- maximisation of bone development which can reduce the later risk of osteoporosis,
- maintenance of childhood aerobic fitness which potentially has a beneficial effect on levels of adult risk of cardiovascular disease.

The potential role of physical activity, as a key component of energy balance, in the prevention and management of obesity may be particularly important in light of increasing levels of overweight and obesity among children and adolescents. In the following sections, evidence for the relationship between physical activity and health in young people will be presented. Where there is a lack of available data for children and adolescents, reference to the adult population will be made.

Overweight and obesity

Obesity has become a major public health concern in recent years and is estimated to account for 2-6% of total health care costs in developed countries (WHO, 2003). In England, the House of Commons Health Committee (2004) recently reported annual economic costs of obesity of £3.3-3.7 billion, including costs related to healthcare, premature mortality and sickness absence. In Scotland, it is estimated that obesity and its associated conditions cost the NHS £171 million a year (Walker, 2003).

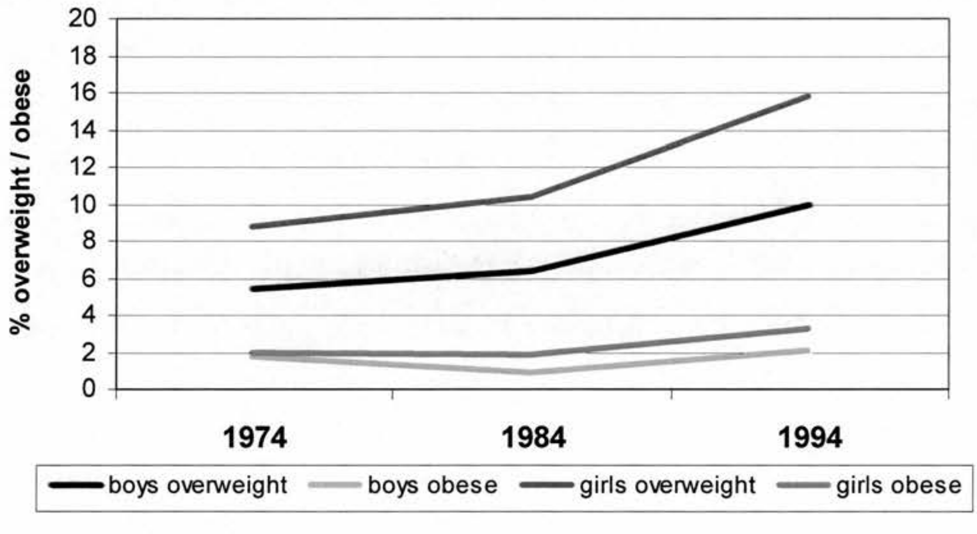
Overweight and obesity are terms used to describe increasing degrees of excess adiposity (body fatness). Body mass index (BMI), defined as weight in kilograms divided by height in metres squared, is one of the most commonly used methods for measuring overweight and obesity. However, a number of limitations of the BMI are recognised, including: not being able to distinguish between fat or lean mass, not necessarily reflecting fat distribution (which may or may not be associated with age), and not necessarily describing the same levels of body fat in different populations because of different body proportions (National Institute for Health and Clinical Excellence, 2006).

Among adults, overweight is defined as a BMI greater than $25kg/m^2$ but less than 30kg/m2 and obesity is defined as a BMI of $30kg/m^2$ or more (WHO, 2000). Among children, however, there is no universally accepted classification system for obesity. Current definitions are based on age- and sex-specific growths charts derived from population reference data, but the cut off points used to define overweight and obesity vary. In the UK, the 85^{th} and 95^{th} centiles have commonly been used to define overweight and obesity, respectively (e.g. Reilly *et al.*, 1999; Rudolf *et al.*, 2001; Bundred *et al.*, 2001). However, more recently, use of the 91^{st} and 98^{th} centiles (for overweight and obesity, respectively) have been recommended by the National Institute for Health and Clinical Excellence (2006) and the Scottish Intercollegiate Guidelines Network (2003), based on the 1990 UK reference charts for BMI percentiles for children (Cole *et al.*, 1995). An alternative classification has been put forward by The International Obesity Task Force (IOTF), based on international data from six countries whereby childhood percentiles are identified which correspond to the adult cut off points for overweight ($25kg/m^2$) and obesity ($30kg/m^2$) at age 18 (Cole *et al.*, 2000). It has been suggested that prevalence studies should present results based on the IOTF cut points as well as national definitions in order to allow for comparison across populations (Chinn, 2006).

Studies of children in the UK have shown increases in overweight and obesity since the 1980s. For example, among 4-11 year olds in Scotland, Chinn and Rona (2001) found that the prevalence of overweight increased from 6.4% to 10% among boys and from 10.4% to 15.8% among girls between 1984 and 1994 (Figure 1.1). By 1994, 2.1% of boys and 3.2% of girls were obese. More recent estimates from the 2003 Scottish Health Survey suggest even greater increases during the last decade; among 2-15 year olds, 18.0% of boys and 13.8% of girls are classified as obese (Hirani & Stamatakis, 2005). This represents an increase between 1998 and 2003 among boys but not girls. It should be noted that these two reports used different criteria to define overweight and obesity and therefore the data are not directly comparable. Chinn & Rona based their analyses on the IOTF cut points proposed by Cole *et al.* (2000) which are considered to result in a more conservative estimate than the 1990 UK BMI reference data (Cole *et al.*, 1995) used in the Scottish Health

Survey. Previous research has found higher levels of overweight and obesity among young people in Scotland compared with England (Jebb *et al*., 2003). However, more recent research has found that, while boys in Scotland are more likely to be obese than their English counterparts, girls in Scotland have lower levels of obesity (ScotPHO, 2007). Research has also found higher rates of overweight and obesity among children from lower socio-economic groups and those from ethnic minority groups (Jebb *et al*., 2003; Yancey & Kumanyika, 2007). From an international perspective, prevalence of overweight and obesity in UK countries is high relative to other European nations. For example, Scotland ranked 11th out of 34 countries participating in the Health Behaviour in School-Aged Children (HBSC) study with a prevalence of 13.1% (Janssen *et al.,* 2005). However, the highest rates are observed in southern European countries (Lobstein *et al.,* 2004).

Figure 1.1: Overweight and obesity among Scottish 4-11 year olds, 1974-1994 *(source: Chinn & Rona, 2001)*



Some have argued that waist circumference may be more appropriate than BMI as a measure of overweight and obesity (ScotPHO, 2007). McCarthy and colleagues (2003) used waist circumference as well as BMI to assess changes over time in overweight and obesity among 11-16 year olds in Britain. Using data from three cross-sectional surveys, they found increases in waist circumference which exceeded those of BMI and thus concluded that BMI data may give an underestimation of obesity among adolescents. Rudolf *et al.* (2004) reported on findings from a 6-year cohort study of 315 children in the north of England; they found increasing overweight and obesity with age when measured by both BMI and waist circumference. However, when they applied the criteria for overweight and obesity recommended by the International Obesity Task Force (Cole *et al.*, 2000), no significant changes over time were found.

As well as being a major risk factor for CHD, obesity is also associated with a wide range of other conditions, including hypertension, breathlessness, sleep apnoea, type II diabetes, certain cancers (breast, endometrial, oesophageal and colon), osteoarthritis, back pain, gallstones and depression. In the UK, it is estimated that around 5% of CHD deaths in men and 6% in women are due to obesity (Petersen *et al.*, 2003). In relation to cancer, around 14% of deaths in men and 20% in women are attributed to obesity (House of Commons Health Committee, 2004). Obesity is the main preventable cause of cancer after tobacco use. In childhood, obesity has been associated with diabetes, lipid disorders, high blood pressure, respiratory problems, sleep apnoea, earlier menarche, low self-esteem, depression and eating disorders. Evidence indicates that adolescent obesity increases the long-term risk of adult morbidity and mortality independent of adult obesity status (Must *et al.*, 1992) as well as increasing the risk of adult obesity (Whitaker *et al.*, 1997). In addition, obese children are often subject to social isolation, discrimination and stigmatisation (Strauss & Pollack, 2003), which have important implications for psychological wellbeing.

Obesity develops as a result of energy imbalance, that is, when the amount of energy consumed as food is greater that the amount of energy used up through bodily functions and physical activity over a sustained period of time. Therefore it is clear that both nutrition (overeating) and physical activity (inactivity) play an important role. The contribution of physical activity to maintaining a healthy weight and preventing obesity has been given increasing recognition in recent years. There is evidence to suggest that per capita energy intake has fallen over the last few decades

(Prentice & Jebb, 1995) but that people are still overeating relative to their energy needs. This is due to increasingly inactive lifestyles resulting, at least in part, from major industrial and technological changes in recent years. According to Boreham and Riddoch (2001), insufficient physical activity is a prime suspect in the aetiology of childhood obesity. Several studies have found an association between levels of physical activity and BMI in children and adolescents (Patrick *et al.*, 2004; Elkins *et al.*, 2004; Kimm *et al.*, 2005). Most recently, Ness *et al.* (2007) found strong dose-response negative associations between MVPA and obesity among children participating in the Avon Longitudinal Study of Parents and Children (ALSPAC). These associations were stronger in boys than girls, suggesting that the relationship between physical activity and obesity varies by gender.

The causes of obesity, however, are varied and complex and include genetic, environmental and behavioural components. It has been described as both a medical condition and a lifestyle disorder (House of Commons Health Committee Report, 2004) but the rapid increases in overweight and obesity observed in recent years would suggest that lifestyle factors are a primary cause (Fox, 2004). Many of the underlying factors contributing to obesity are embedded in the wider socio-environmental context in which we live, the so-called 'obesogenic environment' (Swinburn & Egger, 2004). As well as the widespread availability of calorie-dense, nutrient-poor foods and increasing marketing of such foods directly to children, a number of additional relevant factors have been highlighted (House of Commons Health Committee, 2004), as follows:

- The extra physical activity involved in daily living 50 years ago compared with today has been estimated to be equivalent to running a marathon a week.
- Town planning has prioritised the needs of motorists above those of pedestrians and cyclists, making walking and cycling increasingly unpleasant and dangerous.
- Local neighbourhoods are increasingly perceived by parents as unsafe places for their children to play.
- UK car ownership has increased from 16 million cars in 1975 to 27 million cars today.

- Increased mechanisation and labour-saving devices in the home and workplace have led to a reduction in physical activity in everyday life.
- Only 20% of men and 10% of women are employed in active occupations.
- Television viewing has doubled since the 1960s from an average of 13 hours a week to 26 hours a week.

Childhood obesity is also associated with a number of family variables, particularly parental obesity (positive relationship), socio-economic status (positive relationship), family size (negative relationship) and age of parents (positive relationship) (Dietz, 1991).

Future projections based on current trends suggest that approximately one third of adults will be obese by 2020 and the figure among children may be as high as 50% (House of Commons Health Committee Report, 2004). Interestingly, recent studies have found that the health risks associated with being overweight or obese are lower in individuals who are overweight and fit than in individuals who are normal weight but unfit. According to a review by Welk and Blair (2000), the evidence suggests that the health risks of obesity are largely controlled if a person is physically active and physically fit.

Cardiovascular disease

Evidence for a relationship between physical activity and cardiovascular disease (CVD) in children and adolescents is sparse, as heart disease typically occurs among the adult population. However, some of the key risk factors for CVD first appear during childhood and adolescence. A number of studies have therefore sought to investigate the relationship between physical activity and risk factors for CVD in adolescents. In the Young Finns Study (Rairakari *et al.*, 1997), associations between physical activity and CHD risk factors were assessed. The researchers reported a significant dose-response relationship between physical activity and a favourable serum lipid profile which was especially evident among males. Physical activity was also inversely associated with obesity, but was not associated with blood pressure. Results from the Young Hearts Project in Northern Ireland (Boreham *et al.*, 1997) found that physical activity was favourably associated with blood pressure, lipid profile and cardiorespiratory fitness in boys. Similarly, among girls, sports participation was associated with lower percentage body fatness and increased cardiorespiratory fitness. In the US, an 8-week school-based intervention programme among children with existing risk factors for CVD led to a significant reduction in cholesterol and a small reduction in body fat among the intervention group compared with controls (Harrell *et al.*, 2006).

Clustering of CVD risk factors is now a recognised clinical condition known as 'metabolic syndrome' and encompasses obesity, hypertension, hypertriglyceridaemia, depressed HDL cholesterol (HDL-C) and glucose intolerance or hyperinsulinaemia (Boreham & Riddoch, 2001). No prevalence data were found for metabolic syndrome among children and adolescents in the UK, but a recent study in the USA found that around one in seven children showed three or more risk factors associated with metabolic syndrome (New Scientist, 2003). Several studies have found associations between physical activity and clustering of these risk factors within the paediatric population. Among Danish children participating in the European Youth Heart Study (EYHS), Brage *et al.* (2004) found a significant inverse relationship between physical activity and a metabolic syndrome risk score which was based on a combination of measures including blood pressure, adiposity, and levels of insulin, glucose, triglicerides and HDL-C in the blood. Further findings from the EYHS show a graded negative association between clustering of risk factors and physical activity among 9 and 15 year olds from Denmark, Portugal and Estonia (Andersen *et al.*, 2006).

Diabetes

There is concern over rising levels of type II diabetes among children and adolescents, a condition previously associated mainly with adults. In the USA, it has been estimated that up to 45% of cases of diabetes diagnosed in children are now type II (Fagot-Campagna, 2000). As well as increased risk of coronary heart disease, diabetes can lead to blindness, kidney failure, stroke, osteoarthritis and limb amputation. Early onset increases the likelihood of these adverse health effects occurring at an earlier age. Obesity is the most important risk factor associated with type II diabetes (British Medical Association, 2005). Research suggests that physical activity can have a significant role in the prevention and management of type II diabetes (Hu *et al.*, 1999; Bonen, 1995). Regular participation is essential, as the beneficial changes in glucose tolerance and insulin sensitivity usually deteriorate within 72 hours of the last exercise session (Albright *et al.*, 2000).

Bone health

Bone mass increases during childhood and adolescence, reaching a peak towards the end of the second decade. During puberty, bone accrual is greater in boys than girls and therefore peak bone mass is 30-40% higher in males than females (Hardman & Stensel, 2003). Approximately 70-85% of the individual variance in bone mass is genetically determined (Boreham & Riddoch, 2001). The remaining variance is influenced by environmental factors, such as body mass, calcium intake and physical activity.

Bone is a dynamic tissue and responds to the loads placed on it. Therefore, with greater loads, the load-bearing capacity of bone increases. Evidence suggests that weight-bearing exercise plays a key role in the development of a healthy skeleton and that physical activity during the immediate pre-pubescent and pubescent years may be crucial for maximising peak bone mass (Boreham & Riddoch, 2001). According to the British Heart Foundation (2004), appropriate activity can lead to 5-15% increases in bone mineral density.

From a public health perspective, the main concern relating to skeletal health is osteoporosis, which chiefly affects women. Although osteoporosis is primarily associated with the elderly, it is thought that developing a strong skeleton during the growth years of childhood and early adolescence may be the optimal prevention strategy (Bailey *et al.*, 1996; Vuori, 1996). This is because growing bone has a much greater ability to lay down new bone than mature bone does. In the post-pubescent years, exercise acts mainly to maintain rather than increase bone mass. Thus, late childhood and early adolescence is thought to be a particularly significant time for promoting bone growth and providing some protection against osteoporosis in later life. Findings from the longitudinal Amsterdam Growth and Health Study (Kemper *et al.*, 1995) and the Cardiovascular Risk in Young Finns Study (Valimaki *et al.*, 1994) both provide evidence for a positive relationship between physical activity during adolescence and bone mineral density in early adulthood. Furthermore, Morris *et al.* (1997) investigated the effect of a 10-month high-impact strength-building exercise intervention on 71 pre-menarcheal girls aged 9-10 years. They found an increase in bone mineral density within the intervention group compared with the control group over and above that associated with normal growth. Thus, both longitudinal and intervention studies support the role of physical activity in promoting bone mineral accrual during the pre- and peri-pubertal years.

Mental health

Mental health is a broad term reflecting a complex and multifaceted concept which is, to some extent, socially and culturally defined (Weare, 2000). It represents more than just the absence of mental illness, encapsulating a wide range of psychological, emotional, social, intellectual and/or spiritual factors which contribute to mental wellbeing. As such, definitions vary. From a functional perspective, the Mental Health Foundation (1999) defines children's mental health as the ability to:

- develop psychologically, emotionally, creatively, intellectually and spiritually,
- initiate, develop and sustain mutually satisfying personal relationships,
- use and enjoy solitude,
- become aware of others and empathise with them,
- play and learn,
- develop a sense of right and wrong,
- resolve (face) problems and setbacks and learn from them.

It has been estimated that, at any one time, around one in ten children and adolescents in Scotland will experience mental health problems which are "*so* *substantial that they have difficulties with their thoughts, feelings, behaviour, learning, and relationships on a day to day basis*" (Public Health Institute of Scotland, 2003, p.6). Mental health problems occurring in children and adolescents may include low self-esteem, mood disorders, conduct disorders, depressive symptoms, eating disorders and self-harm. Poor mental health in young people is strongly related to other health and developmental concerns, including lower educational achievement, substance misuse, violence and poor reproductive health (Patel *et al.*, 2007).

There is increasing evidence to suggest that physical activity may play an important role in promoting mental health and well-being. A recent publication setting out a framework for children's mental health in Scotland, 'The Mental Health of Children and Young People: A Framework for Promotion, Prevention and Care' states that, *"physical activity can influence social and emotional well-being as well as physical health... Evidence shows that low confidence or self-esteem, stress and anxiety and body image are closely linked to willingness to participate in physical activity... Being physically active can improve emotional well-being, help with anxiety, depression and low self-esteem and may even contribute to preventing such problems developing"* (Scottish Executive, 2005, p.16).

While exercise has been associated with reductions in anxiety and depressive symptoms and with beneficial emotional effects including increased self-esteem among adults, there has been less research on the effects of physical activity on the mental health of children and adolescents. However, a significant body of evidence is now developing to demonstrate important psychological benefits of physical activity in children and adolescents. Brown and Siegel (1988) investigated the relationship between physical activity, life stress and illness in a prospective study of over 200 American girls aged 11-15 years. They found that physical activity mediated the relationship between life stress and illness. Under high levels of stress, girls who reported more incidents of illness were significantly less active than those reporting fewer incidents. In a sample of over 5000 British 16 year olds, Steptoe & Butler (1996) found that sport and vigorous recreational activity were associated with higher levels of emotional wellbeing, as measured by the General Health Questionnaire.

In reviewing the evidence for relationships between physical activity and mental health outcomes in youth, Strong *et al.* (2005) found a lack of studies in the area and particularly a lack of longitudinal cohorts to allow for analysis of causation. Only anxiety, depression and self-concept had been investigated sufficiently to allow for some conclusions to be drawn. In relation to anxiety and depression, cross-sectional studies suggest a weak negative association with physical activity, with those who are less active reporting higher anxiety scores and depressive symptoms. Intervention studies among clinical populations show strong positive effects of physical activity on both anxiety and depression. In relation to self-concept, studies suggest a moderate positive association between physical activity and physical self-concept. The relationship with other self-concept domains, however, is weaker. Gruber (1986) conducted a meta-analysis of 27 studies which investigated the relationship between physical activity and self-esteem in children. The findings indicated that directed play and/or physical education programmes could contribute to the development of self-esteem in young children. The greatest effect sizes were for children with disabilities and for programmes involving fitness activities.

A review of studies assessing the effects of physical activity on psychological variables in adolescents found the most consistent effects for self-esteem and anxiety / stress (Calfas & Taylor, 1994). The authors argue that physical activity can play a unique role in promoting self-esteem, particularly during adolescent development when mastery experiences and successes in physical activity can contribute towards a positive self-concept. In terms of anxiety and stress, eight out of eleven studies found a positive effect whereby physical activity was associated with reduced anxiety or stress. In a study of factors associated with poor mental functioning which may occur more commonly in the adolescent population, Janssen *et al.* (2004) report a significant relationship between physical activity and psychological health complaints (feeling low, irritability, nervousness and sleeping difficulty) among

Canadian adolescents, with increased frequency of symptoms associated with lower levels of physical activity.

Ekeland *et al.* (2005) undertook a systematic review of the effect of exercise on self-esteem in children and young people aged 3-20 years. A total of 23 papers were included in the review, all of which were based on studies using a randomised-controlled trial or quasi-randomised design. Interventions were a minimum of 4 weeks' duration and focused on gross motor, energetic activity. The authors report a mean difference of approximately 10% between intervention and control groups, both for single interventions and those which were part of larger comprehensive interventions. Despite the need for further research to assess the longer-term sustainability of such effects, the evidence supports the notion that exercise can contribute to the development of a positive self in children and adolescents. Lagerberg (2005) presents a word of caution in relation to delivery of physical activity programmes, recognising that an over-emphasis on skill rather than enjoyment and performance rather than participation may be counterproductive for some children's psychological wellbeing. Indeed, physical activity is particularly beneficial when the focus is on promoting mastery and self-development, especially for those with low self-esteem (Fox, 2001).

Health risks associated with physical activity

Despite the clear health benefits of an active lifestyle, there are also risks associated with physical activity. The best-documented risks are musculo-skeletal injuries, triggering of heart attack or sudden cardiac death, menstrual dysfunction and increased upper respiratory tract infections (Hardman & Stensel, 2003).

Unintentional injury is the most common cause of emergency hospital admissions in children under 15 years of age and is the most common risk associated with physical activity in children and young people. Among a nationally representative sample of Scottish adolescents, sports-related injuries were found to account for 32.2% of all self-reported injuries over a 12-month period (Williams *et al.,* 1998). Incidence of sports injuries was higher among boys than girls and increased with age. Spinks and colleagues (2006) attempted to quantify injury rates associated with physical activity among primary school-aged children in Australia. While the majority of injuries occurring in this sample were associated with physical activity, the overall incidence rate was deemed low, with only 5.7 injuries per 10,000 hours of exposure and 1.7 for injuries requiring professional medical attention.

In some cases, vigorous exercise may trigger heart attack or sudden death due to cardiac arrest. Within the general population, between 6-17% of all sudden deaths are exercise-related (Hardman & Stensel, 2003). The risk of sudden cardiac death following vigorous activity is considerably higher among individuals who are habitually less active compared with those who exercise frequently. It is generally accepted that, in such cases, individuals already have an underlying heart condition. For example, among young adults, sudden exercise-related cardiac death is mainly attributable to congenital cardiovascular abnormalities (Hardman & Stensel, 2003). However, in relation to the potential risks of exercise relative to the benefits for cardiovascular health, Hardman and Stensel (2003) point out that it is important to consider the relative versus the absolute risk. While the relative risk of a cardiac event is much higher during vigorous activity than at other times, the absolute risk during any particular episode of vigorous activity is very low.

Menarche may occur later in female athletes, gymnasts and dancers compared with their less active peers, which has led to concern over the potential effects of very high participation in these activities on girls' reproductive health. It is possible that this observed effect is at least in part due to self-selection of late-maturing girls into these activities. However, among female athletes, studies have shown an association between high-level training and menstrual dysfunction. Athletic amenorrhea can, however, be reversed with weight gain and reduced training and therefore is not in itself a long-term risk to reproductive health. A more significant risk is the decrease in bone mineral density associated with prolonged disruption to menstrual functioning. Amenorrhea (absence of menstruation) or oligomenorrhea (light or infrequent menstruation) in young women who engage in high levels of physical activity and maintain a very lean body weight can lead to decreased bone mineral content and increased risk of osteoporosis in old age (Marti, 1991).

Strategies to reduce the risks associated with high-intensity exercise include use of protective equipment, use of appropriate shoes and clothing, early recognition of symptoms and education on appropriate training regimes. However, most risks are associated with vigorous rather than moderate intensity activities and therefore can be minimised by pursuing an active lifestyle rather than engaging in high volume, high-intensity training.

1.5 Promoting physical activity in children and adolescents

> *"Despite the limitations of the current database, there is substantial evidence that regular physical activity produces multiple beneficial physiological and psychological outcomes during adolescence. The strength and consistency of these findings lead to recommendations for all adolescents to be physically active on a regular basis."*
> (Sallis & Patrick, 1994, p.311)

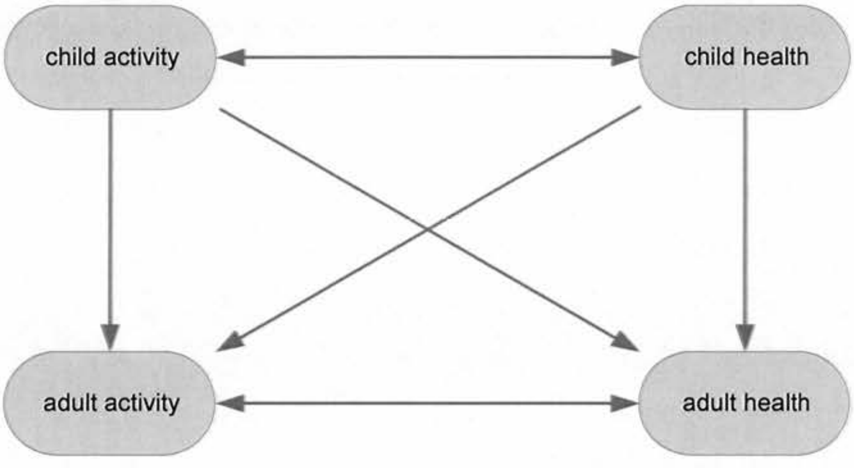
There are three main rationales for promoting physical activity among children and adolescents. These have been described by Blair *et al.* (1989) and Cavill *et al.* (2001) as follows:

- Improving childhood health status and quality of life, including optimising physical fitness, current health and wellbeing, and growth and development.
- Improving future adult health status by reducing risk factors for chronic diseases.
- Developing active lifestyles, thereby increasing the likelihood of being an active adult and, indirectly, enhancing adult health status.

These hypothesised relationships between childhood physical activity and health are illustrated in Figure 1.2.

As evidence of the relationship between physical activity and health grew, guidelines were issued concerning the recommended levels of physical activity for members of the general population. Initially, the evidence accumulated focused primarily on sustained periods of vigorous physical activity and thus the first guidelines to be issued and adopted internationally were for participation in at least 20 minutes of vigorous-intensity physical activity at least three times per week (Sallis & Patrick, 1994).

Figure 1.2: Model of hypothesised relationships between childhood physical activity and child and adult health (*source: Blair et al., 1989*)



However, as research in this field gathered momentum, evidence of similar health benefits accrued through participation in moderate-intensity physical activity became apparent. For example, The British Regional Heart Study, a prospective study of cardiovascular disease in 7735 men aged 40-59, showed a 50% reduction in risk of CVD among men participating in moderate or moderately vigorous physical activity compared with inactive men over an 8-year follow-up. No additional protective effect was found for vigorous physical activity (Shaper & Wanamethee, 1991). Data from this study showed that physical activity not only resulted in a decrease in CVD mortality (risk ratio = 0.66 compared with inactive) but also in non-CVD mortality (risk ratio = 0.46).

Some studies have found greater health benefits of vigorous over moderate physical activity. For example, the Iowa Women's Health Study (Kushi *et al.*, 1997) compared risk of mortality from cardiovascular disease in women aged 55-69 over a

7-year follow-up period. Women who took part in moderate physical activity four or more times a week had a 47% lower risk of cardiovascular mortality compared with inactive or rarely active women, while those taking part in vigorous physical activity four or more times a week had an 80% lower risk. However, such studies tend to be in the minority.

Given the emerging evidence, public health strategy since the early 1990s has focused on promoting participation in regular, moderate-intensity physical activity. The current recommendations emphasise the need to increase physical activity at a population level through encouraging moderate activities which can become habitual and sustainable through integration into the context of individuals' everyday lives (Owen *et al.*, 2000). These contexts include, for example, neighbourhoods and communities, home, recreational settings, workplaces and schools.

There is ongoing debate about the precise criterion for 'sufficient' activity in young people. Most of the evidence on which recommendations are based comes from studies on adults, in which clearer relationships between physical activity and health have been observed. Consequently, physical activity guidelines for children and adolescents have been broadly based on adult recommendations. The current recommendations for 5-18 year olds were published by the Health Education Authority in 1998 (Health Education Authority, 1998) following a process of expert review, consultation and consensus:

- All children and young people should achieve a total of at least 60 minutes of at least moderate intensity physical activity each day.
- At least twice a week, this should include activities to improve bone health, muscle strength and flexibility.

These recommendations have been adopted in the UK and have been established as a key target for children and young people in Scotland in the strategy document '*Let's Make Scotland More Active*' (Scottish Executive, 2003). However, while the recommendations are based on best available scientific knowledge, neither the minimal nor optimal amount of physical activity for young people has yet been precisely determined (Cavill *et al.*, 2001). Recently, there has been some concern that recommended levels of participation may be inadequate to prevent the increasing levels of overweight and obesity among young people (Department of Health, 2004). Furthermore, evidence from the European Youth Heart Study suggests that an hour a day may be an underestimation of the activity required to prevent clustering of risk factors in children (Andersen *et al.*, 2006).

The current target in Scotland is for 80% of all children aged 16 or under to meet the minimum recommended levels of physical activity by 2022 (Scottish Executive, 2003). Evidence shows that the greatest health gains are to be achieved by those moving from low to moderate levels of activity. There are fewer health benefits for those who move from moderate to high levels of activity (Sallis *et al.*, 2004; Pate *et al.*, 1995).

1.6 Summary

The relationship between physical activity and physical and psychological health is now well established. While there are fewer data on young people than on adults, studies do suggest a number of important health benefits for children and adolescents. These include healthy growth and development, maintenance of healthy weight, reduced exposure to risk factors for cardiovascular disease, positive self-esteem and enhanced psychological wellbeing. Accordingly, not only is it important to establish active lifestyles from an early age in order to encourage habits which can be continued into adulthood, but so that young people can enjoy a range of immediate health benefits associated with being physically active.

Physical activity guidelines, based on international expert consensus, have been adopted in Scotland. These guidelines recommend that all young people should participate in at least moderate intensity physical activity for a minimum of 60 minutes a day. The following chapter will review the evidence on current levels of physical activity among children and adolescents and patterning of participation within the adolescent population.

Chapter 2

Physical activity behaviour among children and adolescents

"From a developmental perspective, most children start out with a physically active identity, as evidenced by the ease and willingness with which they run and play when given a chance. As they age, sociological, cultural and personal forces develop, and physical activity becomes more of a choice among multiple options. Some youth maintain their interest and involvement; others begin withdrawing from physical activities." (Welk, 1999, p.18)

2.1 Introduction

This chapter examines current trends and patterns in physical activity behaviour among children and adolescents. Evidence for sharp declines in physical activity participation during the early adolescent years provided the impetus for the current study and the basis for the research design. It has been argued that younger children are biologically programmed to be physically active. However, by the time that children reach adolescence, there is considerable evidence to show that many are not sufficiently active to benefit their health. Children today face increasing environmental and social constraints on their activity levels, such as increased car ownership and usage, parental restrictions on children's independence and outdoor play, and the widespread availability of sedentary home entertainment systems. These issues, combined with the increasing prevalence of overweight and obesity, have led to widespread concerns over levels of physical activity among young people.

Before examining the evidence concerning levels of physical activity participation in children and young people, it is necessary to consider some of the methodological issues around measurement and assessment of physical activity. High quality measures are essential for all types of research. However, measurement of physical activity among children and young people is particularly problematic. This is mainly a reflection of the complexity of physical activity behaviour and the sporadic nature of activity among children and young people. As Armstrong states, "*the assessment of young people's physical activity is one of the most difficult tasks in epidemiological research*" (Armstrong, 1998 p.9). The methods of assessment used in research affect the types of data which result. The first part of this chapter will therefore provide a description and critique of the main methods used for assessing physical activity. The second part will review the evidence concerning trends and patterning of physical activity among children and adolescents.

2.2 Measurement of physical activity in children and young people

Physical activity can be measured from both behavioural and physiological perspectives. A variety of methods exists, including objective measures such as heart rate monitoring, activity monitors, doubly-labelled water and indirect calorimetry, and subjective measures including questionnaires, interviews, diaries and observation. These are discussed in more detail to highlight the strengths and weaknesses of each.

Heart rate monitoring

Heart rate monitoring is an objective means of estimating physical activity. However, it is not a direct assessment of physical activity *per se*, but rather measures the degree of stress being placed on the cardiopulmonary system by an activity (Armstrong, 1998). It therefore provides a direct indicator of the physiological response associated with physical activity (Dale *et al.*, 2002). It can be used to describe intensity, frequency and duration of activity and is often reported as time spent with heart rate above a specified threshold. At least four or more days of monitoring are needed for stable measures of usual physical activity (Janz, 2002).

Key advantages of heart rate monitoring are that the data correspond well with overall energy expenditure (Trost, 2007), it has been shown to be valid for use in children (Welk *et al.*, 2000), and has a relatively low participant burden for short periods of data collection (Sirard & Pate, 2001). However, it can be burdensome over longer data collection periods. In addition, there are a number of important limitations which make interpretation of heart rate data complex. In particular, changes in heart rate may occur due to a range of factors other than physical activity such as changes in emotional state and climatic conditions (Armstrong, 1998). Thus, the relationship between heart rate and physical activity is less secure at lower levels of physical activity (Riddoch & Boreham, 1995). Furthermore, there is a temporal lag in heart rate response to initiation or cessation of physical activity, estimated to be typically 2-3 minutes (Strath *et al.*, 2000).

Accelerometers

Activity monitors have become a very popular technique for assessing physical activity in free-living conditions, with one of the most common being the accelerometer (Trost, 2001). Typically, this instrument assesses acceleration of the body in one or more dimensions and provides a detailed record of intensity, frequency and duration of movement. Data are collected for user-specified time intervals (often one minute) and can be downloaded onto a computer for processing and analysis. As with heart rate monitors, accelerometers can be used in both laboratory and field settings and have the added advantage of being less intrusive. They are consequently associated with lower participant burden and therefore suitable for longer periods of data collection. Recent reviews have concluded that accelerometry provides a practical, accurate and reliable means of measuring habitual physical activity in children (Reilly *et al.*, 2008).

For epidemiological research, a key disadvantage is the financial cost of the instrument which prohibits use with large samples (Welk *et al.*, 2000). Accelerometers also have a number of limitations relating to measurement of physical activity. Studies have shown that belt-mounted motion sensors tend to under-estimate the energy expenditure of many activities because of their inability to detect the metabolic cost associated with standing, upper body movements, vertical lift and pushing or carrying objects (Bassett *et al.*, 2000). Similarly, accelerometers are limited in their ability to detect movement associated with cycling (Sirard & Pate, 2001) and typically cannot be used to assess water-based physical activity. There is also a lack of consensus in relation to the use of prediction equations for converting accelerometer counts into estimates of energy expenditure, especially among children (Trost, 2007). Use of different cut-points for defining MVPA has been shown to have a marked effect on estimations of compliance with current physical activity guidelines among early adolescents (Reilly *et al.*, 2008; Pate *et al.*, 2006).

Pedometers

Pedometers provide a promising means of objective measurement of physical activity as they are relatively low-cost and easy to use. Recent reviews by Tudor-Locke and colleagues have provided support for pedometers as a valid tool for measuring physical activity. For example, pedometer data were found to be strongly correlated with data from accelerometers during unrestricted movement and with time spent in observed activity (Tudor-Locke *et al.*, 2002). A further review (Tudor-Locke *et al.*, 2004) found inverse relationships between pedometer-determined physical activity and body mass index and indicators of body fatness i.e. lower step counts among those with higher BMI or greater percentage body fat. Positive associations were found with indicators of physical fitness.

Pedometers measure the number of steps taken and can estimate distance if stride length is known. Total energy expenditure is estimated based on the measured energy expenditure associated with walking. This, however, provides an underestimation of total energy expenditure as non-locomotor movement is not recorded. Pedometers also provide no measure of rate or intensity and are less accurate when people move slowly or walk with an uneven gait (Crouter *et al.*, 2003).

Doubly-labelled water

Doubly-labelled water is a biochemical technique that is used to estimate energy expenditure by assessing the level of biological markers in urine (Dale *et al.*, 2002). These markers reflect the rate of metabolism within the body. Key advantages of this technique are that it is unobtrusive, non-invasive and provides a precise measure of energy expenditure in free-living children and adolescents (Trost, 2007). However, it is high-cost and also provides no information on patterning of physical activity (Trost, 2007) and therefore has limited usefulness for behavioural research.

Indirect calorimetry

Indirect calorimetry provides a precise measure of total energy expenditure using respiratory gas analysis based on the measurement of oxygen consumption and of carbon dioxide production over a period of time (Sirard & Pate, 2001). Frequency, duration and intensity of physical activity can be assessed using VO_2 level. For shorter time periods, this can be achieved using face masks or mouthpieces, but for longer durations participants have to be confined to a metabolic chamber. Thus, this technique is better suited to laboratory experiments than assessment of physical activity in free-living conditions.

Subjective measures

Self-report methods include questionnaires, check lists, diaries, interviews and proxy measures (e.g. information provided by parents or teachers on activity levels of children). These types of measures are used extensively in studies of physical activity. They are particularly useful for large-scale epidemiological research due to their relative ease of administration and low cost, where the resources (finance and time) required for objective measures may prove prohibitive. Data from self-report instruments may be quantified by assigning kilojoules or MET values to different modes of activities, thus giving an estimation of overall energy expenditure. Alternatively, the data may be used to report patterns of physical activity, including duration, frequency, intensity and mode. Furthermore, from a behavioural perspective, self-report measures have the advantage of being able to provide information about the contexts in which physical activity occurs (Baranowski, 1988).

The main limitation of self-report measures is their vulnerability to recall bias (Trost, 2007). This may be particularly true for instruments which require respondents to recall their physical activity over longer durations, potentially leading to low reliability. Validity may be compromised by social desirability responses and difficulties for younger children in separating the intended self from the actual self (Harter, 1988). This means that younger children may tend towards responding in a way which they consider to be correct or expected, or in a way which reflects how they would *like* to be, rather than how they really are. Indeed, validity of self-report instruments has been shown to be lower among younger children (e.g. Sallis, 1991; Kohl *et al.*, 2000). In general, self-report questionnaires are not recommended for children under the age of 10 because of their limited cognitive abilities (Saris, 1985). These cognitive limitations apply to both interpretation of the questions and processing of responses. In addition, many physical activity self-report instruments require a judgment of time, for example, how long was spent in a particular activity. This is also likely to be more problematic for children than adults as children are far less likely to be aware of specific time periods within a day. Indeed, by using a range of qualitative techniques to explore physical activity recall in children and adolescents, McKenna *et al.* (2004) found considerable overestimates of time spent being active, especially among younger children.

Summary of issues in physical activity measurement

It is clear that physical activity is a highly complex construct with both physiological and behavioural elements and, consequently, its measurement is problematic. Evidence shows that the method used to measure physical activity will influence the findings in relation to physical activity levels. No single technique can completely capture both behavioural and biological components of physical activity (McManus, 2000) or accurately encapsulate all its dimensions, modes and contexts (Fox &

Riddoch, 2000). Subjective measures such as self-report questionnaires have often been criticised for providing less accurate information than objective physiological methods such as heart rate monitoring or motion sensors. However, it has been argued that the mismatch between different methods of physical activity assessment is, in fact, a reflection of the different components of physical activity being measured: "*Observations accurately relay spontaneous activity play bouts in children, but tell us nothing of whether or not these may induce marked physiological changes, such as substantial increases in cardiovascular stress. Heart rate monitoring accurately monitors changes in cardiovascular activity, but tells us nothing of the characteristics of active play behaviour in the child*" (McManus 2000, p135).

Within a research context, the most important consideration is to select the measurement technique which best fits the research question being investigated. Objective measures generally offer greater precision in the estimation of physical exertion and are useful for measurement of energy expenditure at the individual level. However, where the research question is framed within a behavioural perspective focusing on patterning of behaviour, such as participation in different types of physical activity within different behavioural contexts, subjective methods allow for a breadth and depth of information which most objective methods do not provide. Furthermore, objective measures are generally costly and time-consuming to use and are therefore less useful for large-scale field studies.

2.3 Physical activity participation among children and young people

Physical activity behaviour in children has a number of unique characteristics which distinguish it from adult behaviour; these have been summarised by Welk *et al.* (2000) and are shown in Table 2.1. Young people's activity is characterised by short, spontaneous bursts of activity rather than sustained bouts. This has been consistently identified as one of the key features of physical activity behaviour in children and young people. For example, in the USA, Pate and colleagues (2002) found that less than 3% of children (grades 1-12) participated in sustained bouts of vigorous activity of at least 20 minutes three or more times a week. Among adolescents in England, Armstrong and Welsman (1997) found that only 20% recorded a 20-minute sustained bout of moderate-to-vigorous physical activity in a week, but 73% were classified as active when using a 5-minute bout as the criterion.

Table 2.1: Characteristics that differentiate children from adults in physical activity *(Welk et al.,2000)*

Type	Characteristic	Implication
Biological	Need for high level of central nervous system arousal	▪ High volume of PA is typical ▪ Low tolerance for total inactivity ▪ Spontaneous activity is common
Cognitive functioning	More concrete (less abstract) thought processes	▪ Relatively short attention span on any given task ▪ Less interest in continuous activity ▪ Failure to see long-term benefits of activity (e.g. health benefits)
	Less developed cognition	▪ Less accurate recall ▪ Inability to accurately estimate time
Physiological	Limited tolerance for vigorous PA	▪ Activity typically intermittent in nature
	Weak relationship between fitness and PA	▪ Effort does not necessarily result in increases in fitness, thus positive physiological feedback for active behaviour is lacking
Biomechanical	Poorer economy and efficiency of movement	▪ Quicker onset of fatigue and need for frequent rest ▪ Less interest in continuous activity
Psychological	More available free time	▪ More time to try new activities
	Natural curiosity and desire for pursuing new tasks	▪ Interest in exploring new activities

Making assessments about whether children meet current physical activity guidelines will depend on the thresholds which are used for intensity of physical activity and whether cumulative or continuous bouts of activity are included. In their study of 9-

12 year old children, Sleap and Tolfrey (2001) concluded that most children fulfilled the current recommendations when accumulated rather than sustained periods of activity were measured. In Scotland, the Scottish Health Survey provides a national estimate of the proportion of young people meeting current recommendations. Data are gathered through face-to-face interview and the amount of time spent in sport and exercise, active play, walking and gardening is combined to provide a total weekly estimate of time spent in moderate-to-vigorous physical activity (MVPA). The most recent survey undertaken in 2003 (Stamatakis, 2005) shows that around three-quarters of children aged 2-10 years meet the current physical activity guideline (Figure 2.1). Among girls, however, there is a sharp decrease from age 8-10. By 13-15 years, only two-fifths of girls are meeting the guideline and over a third engage in less than 30 minutes of MVPA daily. Among boys, the decline in physical activity begins at age 13-15 years and is less marked than for girls. Figure 2.2 shows accelerometer data from the USA and reveals a similar pattern, with the majority of children meeting the guideline until grade 6 (age 10-11 years), after which levels decrease steadily throughout the adolescent years (Pate *et al.*, 2002).

Figure 2.1: Percentage Scottish children meeting MVPA guideline

(Stamatakis, 2005)

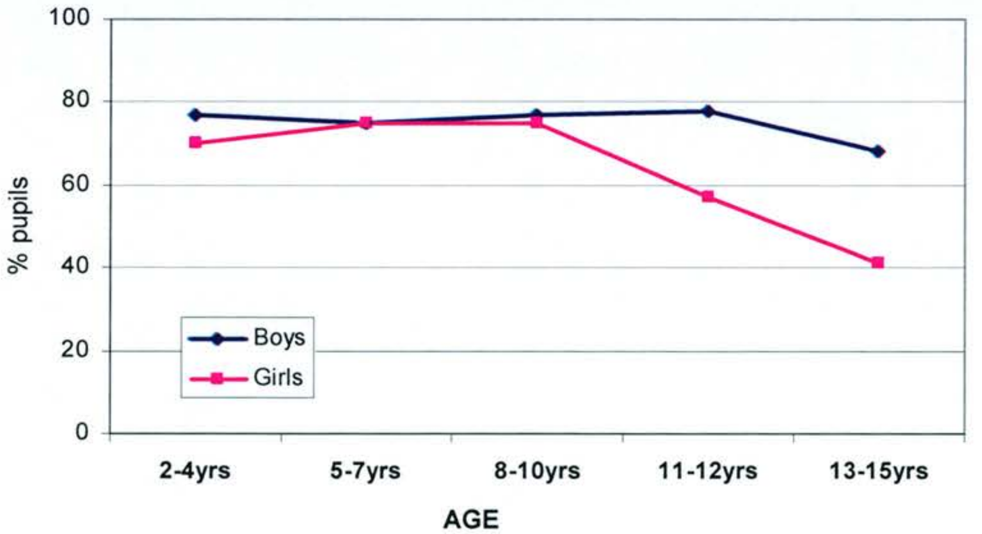
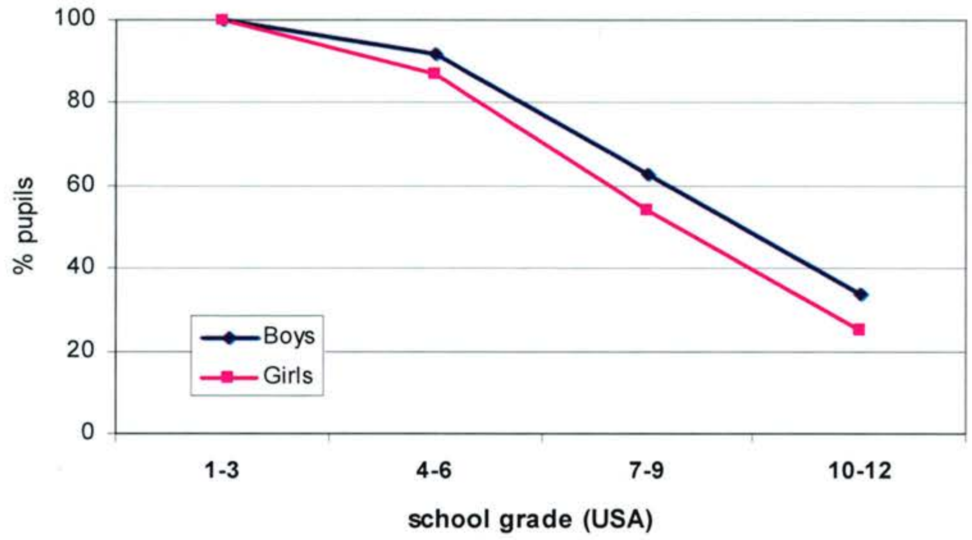


Figure 2.2: Percentage US children meeting MVPA guideline

(Pate *et al.*, 2002)



Similar patterns have also been found in data collected using heart rate monitoring. In a sample of 553 children aged 6-15 years, Armstrong (1998) found that the majority of boys and girls aged between 6 and 10 years accumulated at least 30 minutes of moderate physical activity (≥ 140 beats min-1) a day. From age 10 years onwards, however, there was a sharp decline so that, by age 14, less than 20% of girls and less than 30% of boys did so. In a longitudinal study of changes in weekly hours spent in MPVA among adolescents in the USA (Project EAT-II, Nelson *et al.*, 2006), significant decreases were found among girls throughout the adolescent years. Among boys, declines in physical activity occurred later, during mid to late adolescence.

Physical activity and gender

These findings are consistent with much research in the field which shows that activity levels decline with age and that this decline is more marked among girls than boys. Based on a review of existing data, Sallis (1993) concluded that, during the school years, daily physical activity decreases annually at a rate of 2.7% in boys and 7.4% in girls. These gender differences are apparent as early as age 3-4 years

(Whitfield, 2000), with pre-school boys more likely than girls to engage in exercise play such as running, jumping, climbing and throwing (McManus, 2000). Indeed, evidence suggesting that 'rough and tumble' play increases during the primary years (Humphreys & Smith, 1987; Boulton, 1992) may explain increasing gender differences in physical activity during this period, as boys become more likely to initiate and take part in activities involving physical contact and girls begin to distance themselves from such activities (Fabes, 1994; McManus, 2000).

Armstrong (1998) reported on findings from a number of studies using heart rate monitoring to assess physical activity in children and adolescents. The findings were largely consistent in showing boys to be more active than girls. Furthermore, boys tended to engage in sustained periods of vigorous physical activity more frequently than girls, although this type of activity was not common among young people. Among 12-16 year olds in the USA, Aaron *et al.* (1993) found males to be more active than females on all measures of activity. Males reported a median of 22.5 hours per week of leisure time physical activity compared with 6.6 hours per week among females, and were also more likely to participate in vigorous exercise and competitive athletics than females.

Physical activity and age

Declines in physical activity typically begin around age 10-11 years and the most significant decreases appear to occur during the transitional period from childhood to adolescence, at a time when physical activity makes an essential contribution to normal growth and development. The fact that, prior to this age, most children appear to meet the current guideline suggests that younger children are more naturally active. Indeed, a number of researchers have argued the case for a biological drive for physical activity which is particularly evident during early childhood. According to Rowland (1999), evidence supports the existence of a biological control centre, or "activity-stat", within the central nervous system which regulates daily energy expenditure through physical activity. A wide range of human functions is regulated by homeostatic control centres which work by establishing threshold points, feedback mechanisms and precise tolerance limits. Therefore, Rowland argues, "*as an adequate supply of energy is crucial for sustaining physiological function, it should be expected that a similar control centre should exist for maintaining an energy steady state. Such a centre would balance "energy in" by affecting appetite with "energy out", achieved by regulating resting metabolic rate as well as expenditure in the form of physical activity*" (Rowland, 1998, p.393).

The existence of 'play' activity, observed both in children and young animals, lends support to the idea of biological regulation of physical activity. Play is typically characterised by spontaneous, free, voluntary movement and appears to have no specific purpose. However, it has been suggested that the biological purpose of physical activity, as reflected in play, is related to motor and neural development (Byers, 1998; Ekblomb & Astrand, 2000) and is to prepare one's motor ability for optimal functioning in adult life (McManus, 2000). Play behaviour in young children provides the opportunity to explore and interact with their physical and social environment, to develop basic motor skills and to enhance sensory function. Among both humans and animals, play behaviour is more common in the young and it is believed that the biological drive for physical activity declines with age, reaching a critical point during the adolescent years (Rowland, 1999). One potential explanation for this is that, in the young, play may be a means of maintaining optimal arousal of the central nervous system (CNS), providing constant sensory input to maintain stimulation (Rowland, 1998; Ellis, 1973) but that, with age, stimulation of the CNS increasingly comes from alternative sources (Thorburn & Proietto, 2000).

Like other biological control mechanisms, intrinsic regulation of physical activity can be overridden, at least temporarily, by extrinsic factors (Rowland, 1998). Thus, the existence of an intrinsic control centre does not undermine the importance of external influences on behaviour. Indeed, this may be evident in recent work by Reilly *et al.* (2004) who found that levels of physical activity among young children in Glasgow were much lower than previous findings have indicated. Reilly and colleagues measured total energy expenditure, time spent in sedentary behaviour and time spent in moderate-to-vigorous physical activity among 3-5 year old children.

They found that median time spent in MVPA represented only 2% of monitored hours at age 3 years and 4% at age 5 years. Sedentary behaviour accounted for over three-quarters of monitored time, suggesting that sedentary lifestyles may be established at a very early age.

Physical activity and maturation

> *"It is important to consider physical activity as it relates to the multiple demands of childhood and adolescence associated with physical growth, biological maturation and behavioural development. These processes vary considerably among individuals, occur simultaneously and interact, and provide the backdrop against which youth evaluate their own status among peers."* (Strong *et al.*, 2005, p.736)

The age-related declines in physical activity which are evident during early adolescence typically correspond with the ages at which most children experience the onset of puberty. This has led some to speculate that the adolescent decline in physical activity may be more closely related to maturational stage rather than chronological age. Onset of puberty typically occurs at around 11 years in girls and 13 years in boys (Tanner *et al.*, 1975), although there is considerable variation in both the timing and tempo of puberty within each sex (Rogol *et al.*, 2002). Early adolescence is marked by a number of important changes which reflect the transition from childhood to adulthood, perhaps the most significant being the biological changes associated with puberty. With the exception of foetal and neonatal development, early adolescents undergo the most rapid period of physical growth that humans experience (Brooks-Gunn *et al.*, 1987). This period of growth represents a wide range of processes which are primarily determined by genetic and biological factors and is marked by rapid changes in body size, shape and composition (Rogol *et al.*, 2002).

The physical changes and hormonal patterns associated with puberty are thought to shape many dimensions of early adolescent development and experience, including cognitive, psychological and behavioural aspects (Petersen & Spiga, 1982). One of the key areas of interest is the impact of puberty on adolescents' self-perceptions, specifically body image, body dissatisfaction and self-esteem. The physical changes that take place during puberty have the potential to affect how young people feel about themselves and their bodies. Body image concerns and weight control behaviours are thought to be associated with increasing body mass index in early puberty (Striegel-Moore *et al.*, 2001). There are, however, apparent gender differences in terms of the effect of physical changes during puberty. For example, body dissatisfaction has been found to be particularly related to height in boys and weight in girls during the pubertal period (Alsaker, 1996).

Because of the degree of individual variation in pubertal development, much research has been carried out to assess the psychological and behavioural impact of the timing of puberty. Pubertal timing relates to an individual's *relative* development compared with age-related or peer group norms, and research in this area is based on the concept of a "goodness of fit" between an individual's physical development and their adjustment to these developmental changes within a broader psychological and social context. According to Davison *et al.* (2007, p.2392), "early maturing girls may be particularly sensitive to the physical changes accompanying puberty and more vulnerable to the ensuing psychological effects than later maturing girls". Among girls, early maturation has been associated with a range of negative psychological effects including greater depressive feelings (Alsaker, 1992; Stattin & Magnusson, 1990), eating concerns (Brooks-Gunn *et al.*, 1989) and psychosomatic symptoms (Aro & Taipale, 1987; Stattin & Magnusson, 1990). Studies have also shown that the association between puberty and body image is stronger in early-maturing girls compared with on-time or late developers (Duke-Duncan *et al.*, 1985; Stattin & Magnusson, 1990), with higher levels of body dissatisfaction among early maturers (Alsaker, 1996; Williams & Currie, 2000). Among boys, however, early maturation appears to be favourable in relation to physical self concept. Studies have found that early-maturing boys feel more attractive (Tobin-Richards *et al.*, 1983) and are more satisfied with their bodies, appearance and muscle development (Cok, 1990; Simmons & Blyth, 1987; Blyth *et al.*, 1981). In contrast, late-maturing boys report higher levels of body dissatisfaction (Alsaker, 1992).

In light of this, one might expect that, in relation to physical activity, early maturation would be an advantage for boys and a disadvantage for girls. Relatively few studies have assessed the impact of puberty on physical activity and there are some conflicting findings. Data from the European Youth Heart Study, for example, showed no association between maturational status and physical activity (Kristensen *et al.*, 2007). Other research has found that more advanced maturity is associated with lower levels of physical activity, and that this effect is greater among boys (Janz & Mahoney, 1997; Armstrong *et al.*, 2000). Thompson *et al.* (2003a) compared self-reported physical activity among children taking part in the longitudinal Saskatchewan Bone Mineral Accrual Study. Biological age was measured using peak height velocity. They found that sex was a significant predictor of physical activity when comparing boys and girls by chronological age. However, when controlling for biological age, the sex differences disappeared thus suggesting that pubertal development does have an influence on physical activity behaviour. Recently, Baker *et al.* (2007) investigated the effect of pubertal timing on physical activity among girls and found that early maturation was predictive of lower physical activity, after controlling for differences in physical activity and body fat at age 11 years. Thus, there is an emerging body of evidence to support the notion that maturation, or biological age, may have an important influence on physical activity behaviour, and it is possible that this relationship is mediated by perceptions of self, particularly in the physical domain.

Physical activity and ethnicity

Very few data on ethnic variation in physical activity behaviour among young people exist in the UK. This is due, in part, to the small proportion of ethnic minority groups, particularly outside major cities. One review of the evidence for physical activity among the South Asian population in the UK found five studies of children and young people (Fischbacher *et al.*, 2004); all of these reported lower levels of physical activity or physical fitness among South Asian groups compared with white children. However, most of the evidence on physical activity and ethnicity has come from the USA. Here, significant ethnic differences in physical activity participation are frequently reported. In a study of 1245 American adolescents aged 12-16 years old, Aaron *et al.* (1993) found that whites were significantly more active than non-whites. Similar findings among early adolescent females across six locations in the USA were reported by Pate *et al.* (2006).

Physical activity and socio-economic status

Evidence for a relationship between physical activity and socio-economic status (SES) in children and young people is inconclusive. Several authors have reported higher levels of physical activity among higher SES groups using data from the UK and other countries (Sallis *et al.*, 1996; Raudsepp & Viira, 2000a; Currie *et al.*, 2000; Gottlieb & Chen, 1985). Gordon-Larsen *et al.* (2000) analysed data from 17,766 US adolescents participating in the National Longitudinal Study of Adolescent Health and found that family income was positively associated with moderate to vigorous physical activity. In addition, family income was inversely associated with sedentary behaviour (TV viewing and video/computer games). Harrington (2003) undertook research comparing family-based leisure activities among children from low and middle income families in Australia. She found that those from low income families were much less likely to take part in organised, structured sport activities. Similarly, data from the HBSC study in Scotland show clear SES differences in participation which have persisted for over a decade (Inchley *et al.*, 2005). Participation in vigorous physical activity was significantly lower among children from low affluence families, with low affluent girls the least active overall. Similar patterns are also observed for moderate physical activity, with young people from more affluent families more likely to meet the current recommendations than those from low affluence households (Levin *et al.*, 2007).

Some studies have reported an inverse relationship between SES and physical activity or fitness, with children from lower SES groups showing higher levels of physical activity. Data from the 1998 Scottish Health Survey suggest that children from lower socio-economic groups may be more active than those from higher SES groups (Shaw & McMunn, 2000). Among Scottish children aged 2-15 years, those from lower classes were more likely to have taken part in active play or walking than children from higher social classes. Participation in sports and exercise was also higher among low-SES boys but both boys and girls from low-SES groups were more likely to have taken part in no sport or exercise compared with their high-SES peers. More recent findings from the 2003 Scottish Health Survey show that, based on the Scottish Index of Multiple Deprivation, girls from lower SES groups are more likely to meet the current physical activity guidelines than those from higher SES groups (Stamatakis, 2005). However, this relationship was not significant for boys and no association was found for either boys or girls when parental occupation was used as an indicator of SES.

Other studies report no significant association between SES and physical activity. For example, using a local area level definition of SES, Aaron *et al.* (1993) found no significant relationship with physical activity among 12-16 year olds in the USA. Using a similar classification of SES based on the economic profile of the school catchment area, Kristensen *et al.* (2007) found no association between SES and physical activity among Danish children aged 8-10 years, but an inverse relationship among children aged 14-16 years. They conclude, however, that this latter finding may be explained by the inability of the measurement tool (accelerometers) to assess cycling behaviour, as cycling is very common in Denmark and was significantly higher among high SES groups. Drawing on UK data, Batty and Leon (2002) found no consistent pattern of association between SES and physical inactivity or low cardiorespiratory fitness. Differences in levels of association between SES and physical activity may, in part, be explained by the use of different indicators of SES or differences in the measurement of physical activity, particularly differences between vigorous- and moderate-intensity activity.

The relationship between SES and physical activity also varies across countries. There is evidence that geographical variation in SES effects may be due to wider cultural influences operating at country level. For example, Hallal *et al.* (2006) report that high family income and higher maternal education are associated with lower levels of physical activity among 10-12 year olds in Brazil. According to the authors, this finding reflects the pattern observed in adults whereby, although higher social class is associated with more leisure time physical activity, non-leisure time physical activity (associated with transportation, occupation and housework) is higher among lower social groups, leading to higher levels of overall physical activity among the latter.

2.4 Trends over time in physical activity among children and young people

There is debate about whether children are less active today than they were in the past. The common perception of our "couch potato" culture suggests that young people spend more time in sedentary activities and less time in physically active pursuits than in previous generations. Boreham and Riddoch (2001) claim that children today expend approximately 600 kcal per day less than their counterparts 50 years ago. This is based on evidence showing that average daily energy intake has fallen during this period (Durnin, 1992) and yet children and young people appear to be getting fatter. However, lack of comparative data makes it difficult to assess the extent to which energy expenditure has changed in recent years. In particular, methodological differences between studies in, for example, indicators of activity, sample characteristics and methods employed make analyses of trends more complex.

Welsman and Armstrong (2000) undertook research in the South of England comparing activity levels of 11-16 year olds in 1999/2000 with those a decade earlier. They concluded that levels of activity had remained relatively stable among the reference population, but that low levels of activity among many of the young people combined with decreases in both moderate and vigorous activity with increasing age were a cause for concern.

Several national and international studies collect data at regular intervals over a number of years using standardised research protocols, thus allowing for assessment of changes in participation over time. For example, the Health Behaviour of School-aged Children (HBSC) Study is a cross-national study of health and health behaviours among adolescents across Europe and North America and currently involves more than 40 countries (Currie *et al.,* 2002). Data are collected by self-report questionnaires every four years among a representative sample of 11-, 13- and 15-year-olds in all participating countries. Participation in vigorous physical activity has been measured over the last 20 years. Analysis of trends in frequency of vigorous physical activity between 1985/86 and 2001/02 across seven countries found that, in general, participation remained stable during this period. Only among Finnish adolescents was a small, consistent increase observed over this time (Samdal *et al.,* 2006).

In the USA, the Youth Risk Behaviour Surveillance Study (YRBSS) was developed by the Centers for Disease Control and Prevention to monitor priority health risk behaviours among young people. Data from this study found no change in the proportion of inactive children (those not participating in any moderate or vigorous physical activity during the last seven days) between 1999 and 2005[a]. Similarly, findings from Project EAT-II among high school students in the USA also found no evidence of significant secular changes in MVPA between 1999 and 2004 (Nelson *et al.,* 2006).

Thus, there is no conclusive evidence to suggest that children's overall energy expenditure has increased or decreased in recent years. It is clear, however, that a number of socio-cultural changes have taken place which may restrict opportunities to be physically active. For example, there have been concerns in recent years that children's freedom to play independently is being curtailed, mainly due to safety concerns such as 'stranger danger' and road traffic. Play is the spontaneous activity in which children engage to amuse and to occupy themselves (Burdette & Whitaker, 2005) and is considered important as the means by which children explore and engage with their world and interact with others. According to Piaget (1962), play reflects what children are learning physically, cognitively, socially and emotionally. However, evidence indicates that social changes are leading to increasing restrictions on play activities. Hillman (1993) investigated the degree to which children were

[a] www.cdc.gov/HealthyYouth.yrbs/pdf/trends/2005_YRBS_Physical_Activity.pdf (accessed 28/11/07)

allowed to play away from home and be independent in 1971 and again in 1990. He reported that parental licence for children's independent play decreased during this period and was lower among girls than boys.

Active transportation can also make an important contribution to overall levels of physical activity in young people and, among school-aged children, the journey to school provides an ideal opportunity for active travel. Indeed, there is evidence that children who walk or cycle to school are more active throughout the rest of the day than those who rely on motorised transport (Cooper *et al.*, 2003; Cooper *et al.*, 2005; Alexander *et al.*, 2005) and have higher levels of cardiovascular fitness (Cooper *et al.*, 2006). However, in Scotland since the mid-1980s, the proportion of children walking to school has fallen from 69% to 53% while travel by car has increased from 6% to 21% [b]. Hillman *et al.* (1990) found that the proportion of 7-8 year olds who travelled to school independently decreased from 80% in 1970 to just 10% in 1990. Such changes may be due to a number of factors, but parental safety concerns, increased car ownership and changing parental work patterns are all likely to be important.

2.5 Tracking of physical activity

Tracking relates to the stability of a characteristic and the maintenance of relative position within a group over time. It implies that the most active remain most active, the moderately active remain moderately active and the inactive stay inactive (Malina, 2001). In order to assess tracking, longitudinal observations of the same individual on at least two time points are required. Estimations of tracking are typically made using correlations between repeated measurements. According to the classification system proposed by Malina (1996), correlations of less than 0.30 are low, between 0.30-0.60 are moderate, and greater than 0.60 are considered good.

The belief that physical activity tracks from childhood to adulthood is a major factor in efforts to promote physical activity among children and adolescents. While it may

[b] http://www.scotland.gov.uk/Topics/Statistics/Browse/Transport-Travel/TrendTraveltoSchool (accessed 28/11/07)

be intuitive that active children are more likely to be active as adults, data from prospective longitudinal studies are limited. Malina (1996) reviewed the evidence for tracking of physical activity during childhood and adolescence and between adolescence and adulthood and found that, in general, studies suggest low to moderate tracking. Data from the Allied Dunbar National Fitness Survey (HEA & Sports Council, 1992) showed that adult participation in physical activity in later years was strongly associated with behaviour at an earlier age; 25% of those who reported being very active when young were very active now, compared with 2% of those who were inactive when young. Another study using longitudinal data from the MRC National Survey of Health and Development found that adolescents who had above average ability at school games were significantly more likely to participate in sports at age 36 years (Kuh & Cooper, 1992), thus suggesting that the development of sports-related skills and habits during adolescence may be important.

Using data from the Young Hearts Project in Northern Ireland, Boreham *et al.* (2004) assessed the extent to which fitness and physical activity tracked from adolescence (age 15) to young adulthood (age 22). Tracking of both fitness and physical activity was low but significant in males, but neither showed significant tracking among females. However, different measures of physical activity and fitness were used at each time point, which may have affected the results. Among a Finnish population, Tammelin *et al.* (2003) found that sports participation during adolescence was associated with high levels of adult physical activity. Similarly, a prospective study of Swedish adolescents investigated at age 15-18 years, and again at 33-36 years, found that early experience of physical activity decreased the risk of becoming inactive in adulthood (Barnekow-Bergkvist *et al.,* 1996). Measures of physical fitness, such as strength, flexibility and aerobic power, also track significantly across childhood and adolescence but, as with physical activity, correlations are low to moderate. Generally, aerobic power tracks better than physical activity (McMurray *et al.*, 2003); this may be due to the degree to which aerobic power is genetically determined compared with physical activity, which is largely behavioural and influenced by non-inherited personal and cultural factors.

Thompson *et al.* (2003b) undertook a qualitative investigation of the influence of childhood physical activity experiences on adult participation. Among men, three key themes emerged: significant others, size and maturation, and physical ability. Among active adults males, friends and family members had supported and encouraged their involvement in physical activity when they were younger whereas, among inactive adults, these positive social influences had been lacking. Indeed, all inactive men who were interviewed mentioned a lack of parental support and encouragement as a barrier to being active as a child. Late maturation and/or small stature relative to their peers and a perceived lack of ability were also identified as barriers to being active among the inactive adult males. Among women, the three emergent themes were: transition, body image and significant others. The issue of transition arose at various stages of the life-course but was particularly influential during the transition to high school and, later, the transition into family life. Both these stages were identified as times when physical activity participation decreased. The pubertal transition from childhood to adolescence was also seen as a time during which changes in attitudes and behaviour occurred. This is interesting as Malina (1996, p.49) notes that, "*a major factor affecting tracking during adolescence is individual differences in the timing and tempo of the adolescent growth spurt and sexual maturation.*" It may be that gender differences in tracking which have been found in some studies are a reflection of differential effects of puberty and family life on men and women.

2.6 Summary

The characterisation of physical activity behaviour in children and adolescents is dependent on both the type of physical activity assessed and the method of assessment which is used. A range of methods for measuring physical activity are available but, due to its complexity, no one method is able to capture all its different components. Thus, the specific research question of interest must dictate the method which is used to gather the data. For large-scale epidemiological or behavioural research, self-report questionnaire surveys are commonly used. These have the advantage of being relatively cheap and easy to administer and provide an opportunity to gather a lot of information on different aspects of physical activity and the various contexts in which it may occur. The main limitation of the self-report questionnaire is the potential for recall bias and this has been found to be particularly problematic in younger children.

Due to a lack of comparative data, it is difficult to determine how physical activity levels of children today compare with previous generations. However, a large number of studies suggest that many young people are not active enough to benefit their health. There is good evidence to show that physical activity declines with age during the adolescent years and that decreases in participation are particularly marked among girls. In Scotland, by age 15, the majority of girls do not meet the current physical activity guidelines. Thus, the adolescent years may be a particularly high risk period for physical inactivity among girls. Tracking studies provide support for the notion that being physically active during childhood and adolescence increases the likelihood of being an active adult. It is therefore important to promote active lifestyles from an early age.

Chapter 3

Understanding physical activity behaviour: theories and models

"Theoretical models are the starting point for research on human behavior, because theories simplify the complex phenomena under study by suggesting which factors should be studied." (Sallis, 1994, p.2)

3.1 Introduction

Health behaviour models and theories are used to explain the factors that influence behaviour, the relationships between such factors and the conditions under which these relationships occur. In terms of physical activity promotion, they provide important information about how best to develop appropriate interventions. This chapter presents an overview of the main theories of behaviour change which have influenced research into physical activity behaviour from a public health perspective.

Traditionally, theories of behaviour change in relation to physical activity can be divided into one of two main categories: motivational theories and social cognitive theories. Motivational theories tend to focus at an individual level and seek to explain what drives a person to participate in physical activity. Social cognitive theories emphasise the interaction between individuals and their social context. While these two approaches have a different philosophical basis, both recognise the importance of a self-evaluative construct (self-efficacy) and the cognitive assessment of perceived outcomes.

According to Nutbeam and Harris (1999), four theories, focusing mainly on individual characteristics, have been influential in explaining health behaviour within the field of health promotion. These are the (1) Health Belief Model, (2) Theory of Reasoned Action / Theory of Planned Behaviour, (3) Social Cognitive Theory, and (4) the Transtheoretical Model. All four seek to predict behavioural outcomes and are therefore useful for informing the development of interventions. More recently, increasing attention has been given to ecological approaches which encompass individual-level influences as well as factors within the broader social and physical environment which may facilitate or constrain individual behavioural choices. These models and theories are described below with consideration of their relevance to the field of physical activity promotion.

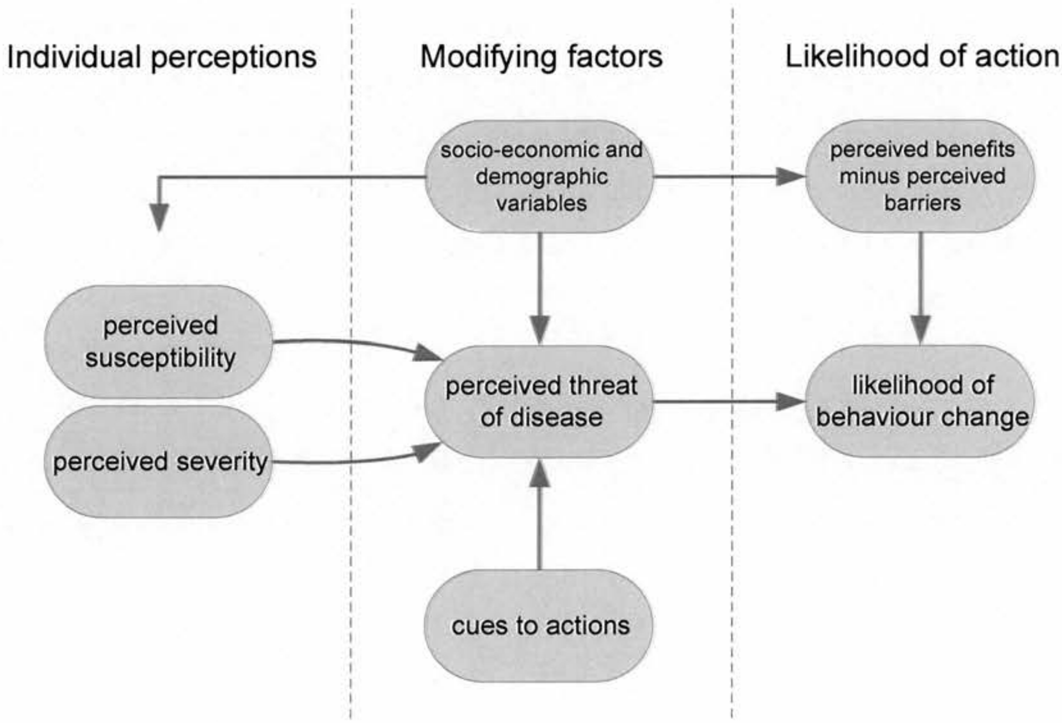
3.2 Health Belief Model

The Health Belief Model (HBM) is one of the oldest health behaviour theories and focuses on psychological explanations of behaviour. It was originally developed to explain the failure of people to participate in health prevention programmes (Rosenstock, 1960). Later it was extended as an attempt to predict health behaviours, particularly in response to low rates of adoption of and adherence to preventive health behaviours (Becker *et al.*, 1974). The model is one of several value-expectancy theories which emphasise the importance of cognitive processes such as thinking and reasoning. Behaviour is seen as the function of the subjective *value* of an outcome and the *expectation* that a particular action will achieve that outcome (Janz *et al.* 2002).

The likelihood of an individual taking action is influenced by four core beliefs: perceived susceptibility, perceived severity, perceived benefits and perceived barriers (see Figure 3.1). Perceived susceptibility is an individual's subjective assessment of the risk of getting a certain condition or illness. Perceived severity is an individual's belief about the severity of the condition or illness and its consequences. Together these constructs are termed "perceived threat". Perceived benefits and barriers are termed "outcome expectations" and refer to an individual's beliefs about the positive and negative consequences of taking (or not taking) action. Action results from a personal cost-benefit analysis in which an individual weighs up the potential advantages of a particular behaviour against perceptions that it may be, for example, expensive, dangerous, difficult, unpleasant, inconvenient or time-consuming (Janz *et al.*, 2002).

Beliefs are modified by socio-economic and demographic variables and cues to action. Socio-economic and demographic factors (for example, age, gender, ethnicity, educational status) are thought to have an indirect effect on behaviour by influencing perceptions of susceptibility, severity, benefits and barriers (Janz *et al.*, 2002). Cues to action are defined as strategies for activating one's readiness to take action and may include, for example, education, symptoms and media campaigns (Janz et al., 2002).

Figure 3.1: Summary of the Health Belief Model Components and Linkages (*source: Janz et al., 2002*)



As the use of the HBM widened to include the explanation of health-promoting behaviours, it was recognised that, in order to undertake behaviour change, an individual must feel confident about their ability to do so. Thus, self-efficacy was added to the model (Rosenstock *et al.*, 1988). Chapter 4 of this thesis provides further discussion on the construct of self-efficacy.

Early reviews of research on the HBM (Becker, 1974; Janz & Becker, 1984) provided support for the model in explaining health behaviour. Of all the constructs within the HBM, perceived barriers was found to be the strongest predictor. Perceived susceptibility was found to be a stronger predictor of health-promoting rather than risk behaviours, whereas perceived benefits was found to have more predictive power for risk behaviours than for health-promoting behaviours. Perceived seriousness was the least powerful predictor (Janz *et al.*, 2002).

In relation to exercise behaviours, Biddle & Mutrie (2001) conclude that the model as a whole has been relatively unsuccessful in predicting the adoption, and/or maintenance, of physical activity and exercise. Criticisms include the assumption that individuals undertaking health behaviours do so in a rational or conscious way, a lack of clarity in the relationships between variables and a lack of consistency in both the operationalisation of variables and measures used. Perhaps its greatest limitation, however, is the failure to take account of social, economic and environmental factors and therefore the HBM is less useful in explaining more complex, socially-influenced behaviours.

3.3 Theories of Reasoned Action and Planned Behaviour

The Theory of Reasoned Action (TRA) was developed by Fishbein and Ajzen (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980) and is based on the assumption that intention is an immediate determinant of behaviour and that intention itself is predicted by attitude and subjective norms. Attitude is a function of beliefs held about a specific behaviour and an evaluation of the extent to which the outcome is important and worthwhile. Subjective norms is a function of the beliefs of significant others and the individual's motivation to comply with significant others.

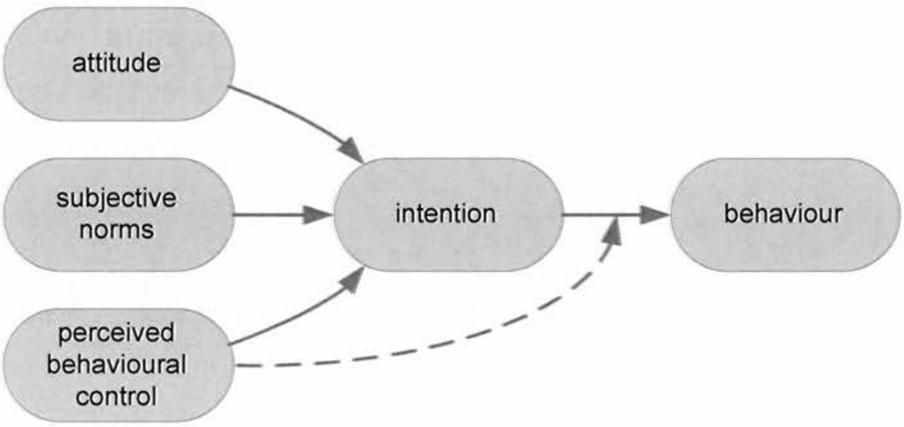
Godin (1993) undertook a review of studies which applied the TRA to exercise promotion and concluded that around 30% of the variance in intention to exercise is explained by attitude and subjective norms. Of these two variables, attitude had the more consistent effect; social pressure did not have a strong influence on intention. Only one of the studies identified had examined the role of TRA variables in relation to physical activity in children (Godin & Shephard, 1986) and, in this case, subjective norms had no significant effect on intention to exercise. Evidence from Godin's review also supports the importance of intention as a predictor of exercise behaviour (Godin, 1993). Similar results were obtained in a meta-analysis undertaken by Hausenblas *et al.* (1997). Large effect sizes were found for the relationships between intention and exercise behaviour, attitude and intention, and attitude and exercise behaviour. Subjective norms predicted intention but not exercise behaviour.

The TRA is subject to a number of criticisms; these have been summarised by Biddle & Mutrie (2001), as follows:

- It is a unidirectional model and therefore fails to take account of potential reciprocity of variables
- It omits key variables which are now known to be important e.g. environmental factors
- It does not take into account prior behaviour
- It was developed to explain behaviours under volitional control but this is not always true of physical activity, especially among children and young people
- It does not address the issue of competing behaviours and personal priorities
- The extent to which intentions predict behaviour will depend on the stability of intentions over time.

The Theory of Planned Behaviour (TPB) is an extension of the TRA, based on the recognition that not all behaviours are under the same degree of individual control. Therefore, in order to improve the predictive power of the model, an additional variable, 'perceived behavioural control', was added (Figure 3.2). This has been defined as the perceived ease or difficulty of performing a behaviour (Ajzen, 1988). Subsequently, Ajzen (1991) defined it in terms of perceived resources and opportunities and perceived ability to overcome obstacles. It therefore reflects past experience as well as anticipated barriers. Some authors have commented on the similarity between perceived behavioural control and self-efficacy, but studies have found that they make independent contributions to the prediction of intentions and behaviour.

Figure 3.2: Theory of Planned Behaviour *(Ajzen, 1991)*



Several studies have provided support for the TPB in relation to physical activity. Among adults, Godin (1993) found that the addition of perceived behavioural control to existing TRA variables explained a further 4-20% of the variance in intention to exercise. There was, however, only partial support for the usefulness of perceived behavioural control in predicting exercise behaviour directly. Based on their meta-analysis, Hausenblas *et al.* (1997) concluded that the TPB is a better predictor of exercise behaviour than the TRA. Similar results were reported by Wankel *et al.* (1994) who found that the TPB accounted for a substantially greater amount of the variance in intention to exercise than did the TRA. Mummery *et al.* (2000) tested the applicability of the TPB to predicting intention to be active in a sample of 677 Canadian children aged 8-16 years. They found that, in combination, attitudes, subjective norms and perceived behavioural control accounted for 47% of the variance in intention. They also found evidence of developmental variation, suggesting that different constructs in the model may be more significant at different stages of maturation. In a study of over 16,000 students from across Europe, the belief in the importance of regular exercise for health was found to predict regular exercise, although the predictive effect differed within and between countries (Steptoe *et al.*, 1997).

3.4 Social Cognitive Theory

Social Cognitive Theory (SCT), previously known as Social Learning Theory (SLT), was developed by Bandura (1986, 1997) and is based on the principle of 'reciprocal determinism' i.e. the way in which behaviour and the environment continuously interact and influence each other. According to Baranowski *et al.* (2002, p.168), *"within SCT, behavior is depicted as dynamic, depending on aspects of the environment and the person, all of which influence each other simultaneously."* SCT is essentially a competence-based theory, centred on the idea that human behaviour is influenced by an individual's perceptions about the future consequences of a behaviour and their own ability to perform that behaviour (McKenna & Riddoch, 2005). Thus, two psychological factors are considered central to the prediction of behaviour change:

1. Outcome expectancy = a person's estimate that a given behaviour will lead to certain outcomes (includes the subjective value placed on a given outcome)
2. Self-efficacy = the belief that one can successfully perform the behaviour required to produce an outcome.

Both self-efficacy and outcome expectancies must be at the same level of specificity as the behaviour itself (Biddle & Nigg, 2000). Within SCT, self-efficacy is seen as the most important influence on choice, effort and persistence (McKenna & Riddoch, 2005). Sallis and Hovell (1990) found that self-efficacy was one of the strongest variables associated with exercise behaviour. It has been associated with physical activity in adolescent girls (Biddle *et al.,* 2005) and Dishman *et al.* (2004) demonstrated that self-efficacy mediated the effect of an intervention to increase physical activity in adolescent girls, thus indicating the importance of self-efficacy in behaviour change processes. Further information about the conceptualisation of self-efficacy is provided in Chapter 4. Despite evidence showing the importance of self-efficacy as a determinant of physical activity, current social cognitive theoretical frameworks generally only explain about 30% of variance in physical activity behaviour (Rhodes *et al.*, 2004).

3.5 Transtheoretical Model

The Transtheoretical Model of Behaviour Change (TTM) was developed by Prochaska and DiClemente (1983) to describe and explain the process of behaviour change, initially in relation to smoking cessation. It has since been applied widely in health promotion research and practice and has proved useful in programme planning because of its ability to identify different needs of subgroups within the population. Commonly referred to as the "stages of change" model, it is based on the idea that behaviour change is a *process* rather than a single event and describes five stages of motivational readiness which are proposed as common to most behaviour change processes. In relation to physical activity, these five stages may be described as follows:

1. Precontemplation (currently inactive and no intention to change)
2. Contemplation (currently inactive but intending to change in next 6 months)
3. Preparation (committed to becoming active, but not yet regular)
4. Action (regularly active, but only began in last 6 months)
5. Maintenance (regularly active for more than 6 months)

The TTM is circular rather than linear and therefore represents a dynamic process of change. Successful behaviour change rarely occurs at first attempt and individuals may move between stages frequently as they try to change their behaviour or they may remain in one place for a long period of time. A sixth stage, 'termination' is described as the point at which individuals are no longer tempted to revert to previous stages and have complete self-efficacy in relation to the behaviour. However, this final stage may take years to achieve and, for many, it is an idealistic goal (Prochaska *et al.*, 2002) and therefore is rarely considered within intervention programmes.

As well as the five stages of behaviour change, the TTM also proposes a set of ten processes of change which people may use as they change their behaviour. These include cognitive, affective and behavioural strategies to aid individuals as they progress through the stages of change. They provide important guides for intervention programmes. The TTM also stresses the importance of self-efficacy and decisional balance. Decisional balance relates to an individual's evaluation of the costs and benefits of engaging in a particular behaviour and is thought to be important in the decision-making process. Self-efficacy is the situation-specific confidence that people have that they can cope with high-risk situations without relapsing into unhealthy or risky behaviour (Prochaska *et al.*, 2002). High self-efficacy helps individuals to overcome the temptation to withdraw from the behaviour change process when difficult circumstances arise. Among adolescents, self-efficacy has been found to increase as they progress through the stages of change (Nigg & Courneya, 1998).

With the exception of tobacco use and prevention, exercise has been the focus of the greatest number of published studies on the TTM (Spencer *et al.*, 2006). A recent meta-analysis found that, in general, core constructs differ across stages and changes are in the direction predicted by the model, thus providing support for the application of the TTM to physical activity (Marshall & Biddle, 2001). However, of the 80 independent data samples included in this meta-analysis, the vast majority were from adult populations. Very few studies have examined the application of the TTM to physical activity behaviour in adolescents.

Nigg & Courneya (1998) tested TTM constructs among Canadian high school students and report preliminary support for the applicability of the TTM to adolescent exercise behaviour. The processes of change each differentiated at least one stage of change from another. Self-efficacy and pros increased across the stages of change from precontemplation through to maintenance, while cons decreased from contemplation/preparation to maintenance. The study examined leisure time activity only, but the authors fail to provide a clear definition of terms. Thus, the extent to which the TTM may be relevant to different types of physical activity behaviour among the adolescent population is unclear.

More recently, De Bourdeaudhuij *et al.* (2005) examined the applicability of the TTM to a large sample of secondary school children in Belgium. As would be expected from epidemiological studies, girls and older adolescents were more likely to be categorised as in the first three stages (precontemplation to preparation). Psychosocial factors (attitudes, self-efficacy, perceived benefits and barriers, and social influence) were found to differ between all stages of change, although there were less pronounced differences between the contemplation, preparation and action stages. Adolescents in the precontemplation stage reported least social support, most barriers, least benefits and very low self-efficacy. A range of physical activity indices were examined including sports participation, travel to school, moderate physical activity and vigorous physical activity. With the exception of walking and cycling to school, adolescents in the precontemplation stage had the lowest activity levels on all PA indices and those in the maintenance stage had the highest activity levels. No significant difference in PA was found between those in the preparation and action stages.

Similarly, Berry *et al.* (2005) found moderate support for TTM constructs among 15-17 year olds in Canada. However, consistent with some of the adult literature (Buxton *et al.*, 1996), strenuous exercise was the only type of physical activity that significantly distinguished between stages of change suggesting that the model may be less applicable to low or moderate intensity physical activity. Of all the TTM constructs, self-efficacy was the strongest predictor of stage, although there was no significant difference between those in the contemplation, preparation and action stages.

Evidence for the application of the TTM to physical activity in adolescents is still limited and, accordingly, Spencer *et al.* (2006) recommend that the model should be used cautiously with this age group. Studies such as those reported above provide some support for its validity and potential use as a framework to guide the development of interventions among adolescents. However, further research is required, in particular intervention studies, to clarify the applicability of the TTM to adolescent physical activity.

3.6 Ecological Approaches

An ecological perspective has been defined as one in which approaches to understanding health behaviour focus on the nature of people's interactions with their physical and socio-cultural surroundings (Sallis and Owen, 2002). It is derived from the term 'ecology' which has its roots in biology and study of the interaction of organisms with their environment.

According to McLaren and Hawe, key themes within an ecological perspective include "*interdependence and mutual interaction among persons and settings, as well as an emphasis on studying behaviour in natural (non-experimental) circumstances*" (McLaren & Hawe, 2005 p.6). In terms of the assumptions made, there are several similarities between human ecology and traditional biological approaches to the study of ecology. For example:

- organisms do not live or function in isolation – they interact with other organisms in a complex network of relationships
- all organisms are affected by internal forces (e.g. genes, biological drives such as hunger) and by external forces (e.g. climate, habitat, group norms)
- living organisms *adapt* to their environment and, in the case of humans, have the potential to alter their environment.

From its origins within a biological discipline, the ecological perspective has developed in several other disciplines, including sociology, psychology, economics and public health, and is now broadly used to describe a multilevel approach to the study of human health and health behaviour within a social and physical environmental context.

From a health promotion perspective, an ecological approach has been defined as "*a conceptual framework designed to draw attention to individual and environmental determinants of behaviour*" (McLaren & Hawe, 2005 p.9). The inclusion of an environmental dimension is what distinguishes ecological theory from other behavioural models and theories. However, due to its multi-dimensional nature, other models and theories can be incorporated within ecological theory in order to enhance specificity within particular domains. Central to ecological theory is the belief that different levels of influence interact with others to affect individual behaviour. The congruence or "fit" between individuals and their social and physical environment is considered an important predictor of wellbeing.

Several researchers have sought to describe the different levels of influence in order to understand the potential mechanisms by which ecological theory may explain human behaviour. Important early work was undertaken by Bronfenbrenner (1979) who identified three levels of environmental influence on individual behaviour which he called the 'microsystem', 'mesosystem' and 'exosystem'. According to Bronfenbrenner, the microsystem includes interpersonal interactions *within* specific settings, for example, between family members, peer groups or work colleagues. The mesosystem represents a higher level of interactions *between* settings, for example, family, school or work. Finally, the exosystem refers to the larger social system in which these interactions occur, including economic forces, cultural beliefs and values and political actions. McLeroy *et al.* (1988) proposed an ecological model of health behaviours which identified five levels of influence: intrapersonal factors, interpersonal processes and primary groups, institutional factors, community factors and public policy. McLaren and Hawe (2005) describe a visual metaphor of a series of nested circles each representing a level of influence on behaviour. These levels of influence include intrapersonal factors, interpersonal factors, organisations, community and public policy.

Stokols (1992, 1996) sets out four assumptions underlying a social ecological approach to health behaviour research:

1. Health is influenced by multiple facets of physical and social environments.

2. Environments themselves are complex and multi-dimensional.
3. Human-environment interactions can be described at varying levels of aggregation for example, individuals, families, communities.
4. Feedback exists across different levels of environments and aggregates of people (reciprocal causation) i.e. people influence their environments and the changed aspects of the environment then act to influence health behaviour.

Thus, according to Stokols, "*people-environment transactions are characterised by cycles of mutual influence, whereby the physical and social features of settings directly influence their occupants' health and, concurrently, the participants in settings modify the healthfulness of their surroundings through their individual and collective actions*" (Stokols, 1992 p.8).

There is now a strong movement towards drawing on ecological theory in the development of strategies and programmes aimed at improving health. In terms of interventions, evidence suggests that multilevel approaches derived from ecological theory may be essential to bring about desired improvements at a population level (Sallis & Owen, 2002). One example of the importance of a broad, environmental approach to behaviour change can be found within the field of tobacco control. Research has shown that individual-level interventions have had limited impact. Greater progress has been made through targeting social norms, policy and regulatory initiatives, as well as environmental changes, such as reducing the availability of cigarettes (Warner, 2000).

Since the early 1990s there has been a renewed interest in ecological approaches to understanding health and health behaviours, both in terms of a shift in focus towards investigating the health of populations and an increasing recognition of the need to explore the effects of cultural, social and environmental influences on the health of individuals. McLaren and Hawe (2005) argue that this has come about due to a range of factors, including: increasing acknowledgement of the complexity of public health problems; frustration with individualism and linear approaches to causality; the rediscovery of the link between social inequality and health inequality; and evidence of an independent effect of place of residence on health which has led to a need for analysis of context in order to provide explanation for such effects.

In relation to physical activity behaviour, there is evidence to suggest that ecological models may provide a useful framework for the development of interventions. To date, interventions have not produced substantial or long-term increases in physical activity (Sallis and Owen, 1999), suggesting that some of the key explanatory factors are not accounted for within existing theories and models. Studies investigating the influence of environmental factors on physical activity provide promising findings. For example, social and physical environmental factors have been found to explain between 40% and 60% of the variance in students' physical activity within the school setting (Sallis *et al.,* 2001).

3.7 Summary

Based on the ability of the models and theories described in this chapter to explain health behaviours and physical activity in particular, a number of key points arise (Nutbeam & Harris, 1999). Firstly, an individual's fundamental knowledge and beliefs about health are central to the behaviour change process. Individuals need to believe that a behaviour is important, relevant and beneficial to them and have sufficient underlying knowledge to inform these beliefs. However, knowledge and beliefs alone are insufficient to initiate change. An individual's belief in their own ability to take action (self-efficacy) is considered of key importance in most behaviour change theories. Observational and participatory learning techniques are both important means of developing personal skills and confidence to promote self-efficacy.

While individual level factors are important, theories which do not take account of broader socio-environmental influences are limited in their ability to explain or predict behaviour. Social cognitive approaches have been highly influential in terms of recognising the reciprocal relationship between individuals and their environment and the important role of significant others in influencing behaviour. However, it seems that ecological models may hold the greatest potential for understanding complex health behaviours such as physical activity. According to Sallis & Owen (2002, p.479), "*a consensus seems to be emerging that multilevel interventions based on ecological models are promising approaches in health behaviour research and for disease prevention and health promotion efforts.*"

It is essential that public health interventions are based on research evidence that identifies the key interpersonal, intrapersonal, socio-cultural and environmental correlates of health behaviour. The following three chapters therefore provide an overview of factors which may relevant to physical activity behaviour and highlight key research findings which contribute to the evidence base for the promotion of physical activity among children and adolescents.

Chapter 4

Psychological determinants of physical activity

"How children feel about themselves represents a crucial component in child growth and development." (King, 1997, p.68)

4.1 Introduction

This chapter reviews the evidence for the influence of psychological factors on physical activity participation. It aims to identify those factors which may be important for the promotion of physical activity among children and adolescents with a view to guiding the selection of psychological variables for inclusion in the present study. Sallis *et al.* (2000) examined the evidence for relationships between psychological variables and physical activity in their review of 108 studies of correlates of physical activity in children and adolescents. Among children (aged 4-12 years), only intention to be active and preference were positively associated with physical activity and there was a negative association between general barriers and physical activity. No association was found for self-esteem, body image and perceived benefits, and findings were inconsistent for perceived competence, self-efficacy and attitudes/outcome expectations. Among adolescents (aged 13-18 years), studies showed a positive association between physical activity and perceived competence, intention and achievement orientation. A negative association was evident between depression and physical activity. No association was found for self-esteem, general barriers, enjoyment or stress, and findings were inconsistent for self-efficacy, body image, attitudes and perceived benefits.

Gorely (2005) argues that many of the inconsistent findings reported by Sallis and colleagues may be due to methodological differences and measurement issues in the original studies. There is therefore merit in further investigation. Furthermore, this review was published several years ago and more recent studies may help to clarify associations. Some of the most commonly researched psychological factors are discussed in more detail below. These have been categorised into two groups; (a) self-perceptions (including self-esteem, perceived competence, self-efficacy, body image and body satisfaction), and (b) attitudes (including enjoyment, intention, perceived benefits and perceived barriers). Within the context of physical activity research, these factors are central to social learning and motivational theories of behaviour, with both approaches sharing a self-evaluation construct (self-perceptions) and a cognitive assessment of perceived outcomes (attitudes). It is worth noting that many of these factors may, in turn, be enhanced or diminished by young people's experiences of physical activity; however, the impact of physical activity on psychological outcomes was discussed in Chapter 1 and will not be further explored here.

4.2 Self-perceptions

Self-concept is considered a core element in explanations of human behaviour. It influences the way in which individuals perceive and interpret the external world. According to Lee (1996, p.35) self-concept refers to "*one's competencies and characteristics, their relative importance and a general sense of self-worth.*" Shavelson *et al.* (1976) describe self-concept as an individual's perception of self, formed through experience with their environment, interactions with significant others, and attributions of his or her own behaviour. It is a dynamic construct which is subject to change over time. In children, the following developmental patterns have been observed (Lee, 1996):

- Children demonstrate the capacity to identify different facets of self by age 5.
- Increasing differentiation occurs with increasing age.
- Representations of self become increasingly abstract and less concrete with increasing age.
- Self-esteem is typically high in early-to-mid childhood, decreases in late childhood and adolescence and then increases again in late adolescence.

Young children are, by nature, egocentric and have not yet developed the capacity to compare their own ability with that of others. Perceptions of self are self-referenced rather than normative and therefore the high levels of self-esteem typical in early- and mid-childhood may reflect perceptions of expectations and achievements which are untainted by comparison with others. In late childhood and early adolescence, children's perceptions become more differentiated and abstract and are increasingly likely to be referenced against external criteria. As children learn to compare their own ability to that of others, levels of self-esteem may decline. Consequently, at this stage, sources of information which children use to assess their own competence become particularly important. Significant sources may include peers, family members and teachers.

For many years, self-concept was operationalised as a broad, global construct and there was little attempt to differentiate between component domains. It is now generally accepted to be multidimensional and hierarchical in nature, whereby perceptions and behaviours in specific sub-domains contribute to the construction of more general domains which in turn contribute to the overall sense of self. Despite general agreement about the hierarchical nature of self-concept, Kowalski *et al.* (2003) argue that there is still some debate over the direction of flow within the model hierarchy. They suggest that there are three potential options:

1. "*Bottom-up*", whereby situation-specific experiences influence perceptions in a specific sub-domain which in turn influences domain-specific self-concept and subsequently global self-concept.
2. "*Top-down*", whereby global self-concept is the dominant construct and perceptions at this level generalise downwards to specific domains and subsequent situation-specific experiences.
3. "*Reciprocal flow*", in which causal relationships occur in both directions.

Furthermore, support for the hierarchical structure of self-concept has generally come from cross-sectional studies. Findings from some longitudinal studies suggest that horizontal effects are strongest over time and provide little support for hierarchical effects (Marsh & Yeung, 1998; Kowalski *et al.*, 2003).

Self-esteem

Self-esteem is the evaluative component of self-concept and has been described as follows:

"By self-esteem we refer to the evaluation which the individual makes and customarily maintains with regard to himself: it expresses an attitude of approval or disapproval, and indicates the extent to which the individual believes himself to be capable, significant, successful and worthy. In short, self-esteem is a personal judgement of worthiness that is expressed in the attitudes the individual holds towards himself." (Coopersmith, 1967, p.4-5)

The degree to which an individual feels valued by others, experiences success in achieving their aspirations, and feels significant and competent are all believed to contribute to their self-esteem (Coopersmith, 1967). Several writers (e.g. White, 1963; Branden, 1969) have made links between self-esteem and feelings of efficacy and competence whereby one's experiences of success or failure influence one's evaluation of self. High self-esteem represents a favourable evaluation of oneself which reflects positive feelings of self-worth, self-respect and self-confidence but not necessarily feelings of superiority to others (Rosenberg, 1963).

Self-esteem can be seen as both a developmental process and an outcome (Mruk, 1999). As an outcome, it is the result of developmental processes during childhood which 'produce' a certain level of self-esteem in an individual. This, in turn, may then influence future experience, motivation and behaviour. There is also evidence, however, to support the notion that self-esteem is a non-stable construct. An individual's judgement of self is subject to changing external contexts and information, and self-esteem is therefore an ongoing developmental process which may change over time. Indeed, the many internal and external changes associated with the adolescent transition are thought to have a significant impact on self-esteem.

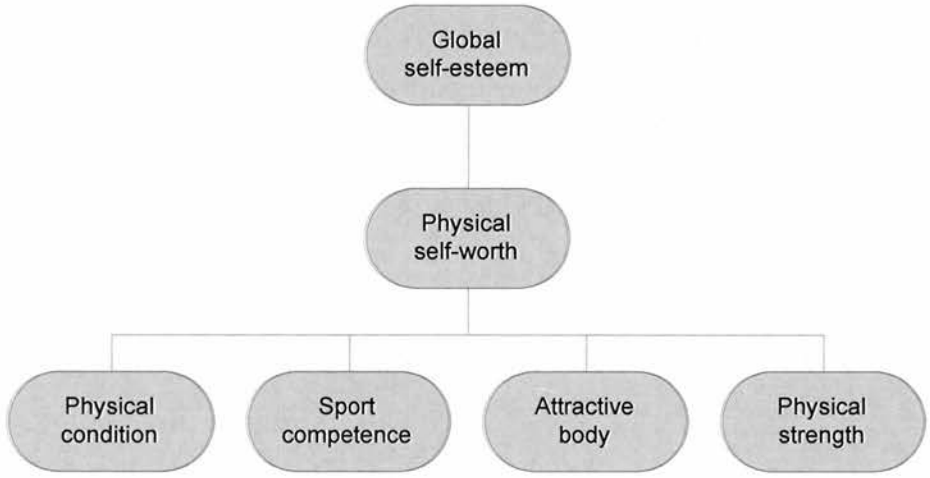
The quest for identity is at the heart of adolescence and self-evaluation is a core element of identity formation. Yet, self-perceptions are particularly vulnerable at this stage of life as adolescents' awareness of the social environment and their role within it increases. Typically, self-esteem decreases in late childhood / early adolescence and then increases again in late adolescence and through into adulthood, although not all children will conform to this pattern. Some have argued that the concurrent timing of school transition and puberty accounts for declines in self-concept during this period (Blyth *et al.,* 1983; Simmons & Blyth, 1987). Harter (1993) suggests that unconditional support from significant others is of major importance for promoting self-esteem in early adolescence. Conversely, conditional support which is based on achievement or adherence to specific behaviours or attitudes can have a negative effect on self-esteem.

Global self-esteem is made up of perceptions of self in a number of different domains, including academic, social and physical. In relation to physical activity behaviour, perceptions in the physical domain are of particular interest. Judgements about the physical self are thought to play an important role in the construction of global self-esteem among adolescents and are likely to impact on behaviour. According to Maiano *et al.* (2004, p.54), "*the physical self occupies a unique position in the self-system because the body, through its appearance, attributes and abilities, provides a substantive interface between the individual and the world.*"

Fox was one of the original researchers to investigate the content and structure of self-esteem in the physical domain. His work involved the use of extensive qualitative techniques among US college students (Fox & Corbin, 1989; Fox, 1990) and led to the identification of four sub-domains of physical self-esteem: body attractiveness, sport competence, strength competence and physical condition (see Figure 4.1). Whitehead (1995) tested the structure of Fox's model among 10-12 year old children and found evidence to support the four domains of physical self worth and a hierarchical relationship between physical self worth and global self-esteem. They found the lowest self-esteem and physical self worth scores among children who scored low on the four sub-domains but for whom the sub-domains were considered important. Further work among school-aged children has also provided support for Fox's proposed hierarchical structure of physical self-esteem (e.g. Welk *et al.*, 1995; Maiano *et al.*, 2004 & Eklund *et al.*, 1997).

Fox (1997) argues that there is good evidence to support the role of physical self worth as a mediator of the relationship between situation-specific physical self-perceptions and global self-esteem. For example, the correlation between physical self worth and global self-esteem has consistently been in the region of 0.6. Furthermore, perceptions in the four identified sub-domains typically explain 65-75% of the variance in physical self worth. Consequently, physical self worth appears to be a useful indicator of the general wellbeing of individuals in the physical domain (Fox, 1997).

Figure 4.1: Hierarchical model of physical self-esteem *(source: Fox, 1998)*



Research among children and adolescents has shown clear gender differences in global self-esteem and physical self worth, with boys tending to score more highly on measures of these constructs than girls (Whitehead & Corbin, 1997; Maiano *et al.*, 2004). However, evidence for a relationship between self-esteem and physical activity appears to be mixed. For example, in a study of 72 boys and girls aged 11-12 years, Biddle & Armstrong (1992) found no significant association between physical self worth or self-esteem and physical activity measured as percentage time with heart rate above 139 or 159 beats per minute. However, when classified as 'active' or 'less active', active girls had higher scores for both physical self worth and global self-esteem than the less active girls. There was no difference in scores between active and less active boys.

More recent work by Crocker *et al.* (2000) among Canadian children aged 10-13 years found that physical self-perception variables predicted 27-29% of the variance in physical activity scores, suggesting that self-esteem may be an important determinant of physical activity behaviour. Gilson *et al.* (2005) also used Fox's model to test the association between self-esteem and physical activity. They found that the relationship differed by gender and activity type. Among boys, higher scores on physical self worth and the sub-domains of sports competence, physical condition and physical strength were significantly associated with increased frequency of sport and exercise participation. Conversely, high sports competence was negatively associated with lifestyle (moderate-intensity) physical activity. Among girls, only strength competence was positively associated with sport and exercise frequency but higher scores on physical self worth and all four sub-domains were significantly associated with increased lifestyle physical activity. Among Swedish adolescents, physical self-perceptions were found to explain 20% of the variance in physical activity behaviour (pedometer step counts) in boys but only 4% in girls (Raustrop *et al.*, 2005). These findings suggest that gender may moderate the relationship between self-perceptions and physical activity.

Body image and body satisfaction

Body image reflects a person's mental representation of their body (Davis, 1997). It is an important component of overall self-concept and comprises both cognitive and emotional aspects i.e. the way we perceive our body and the feelings of satisfaction or dissatisfaction associated with those perceptions. Poor body image and body dissatisfaction have become endemic in western cultures and are thought to have been influenced by media portrayals of increasingly thin and unrealistic standards of attractiveness, especially for females (e.g. Field *et al.*, 1999). Personal factors such as body composition, age and certain personality characteristics (for example, low self-esteem and perfectionism) also influence body image (Davis, 1997). McCabe *et al.* (2002) suggest that body image concerns may be exacerbated by puberty, especially for girls, for whom physical changes associated with pubertal development may take them further away from culturally-defined ideals of the female body. The opposite may in fact be true for boys for whom the physical changes (such as increased height and muscle development) may better correspond with societal ideals.

Research evidence shows significant age effects on perceived body image although these differ for boys and girls. Recent data from the Health Behaviour of School-aged Children (HBSC) study in Scotland shows that 34.0% of girls and 22.5% of boys aged 11 perceive themselves to be too fat (Alexander *et al.,* 2004). While this proportion remains relatively stable among boys between ages 11 and 15 years, among girls it increases to 45.9% of 13-year-olds and 52.3% of 15-year-olds. Similar results were found among a sample of secondary schoolchildren in England; boys had more positive body image scores than girls and, while body image improved with age among boys, there was a significant decline among girls (Duncan *et al.,* 2004a). From a cross-national perspective, data from the 2001/02 HBSC study show that at ages 11, 13 and 15 years, the percentage of girls reporting being too fat was higher in Scotland than the average across all participating countries. Body image concerns therefore appear to be highly prevalent among adolescents in Scotland, particularly among the female population.

Relatively little research has been undertaken to examine the relationship between body image and physical activity in children and adolescents. Sallis *et al.* (2000) identified four studies among children and seven among adolescents. While there appeared to be no significant association in children, findings among adolescents were inconsistent. Duncan *et al.* (2004) found no association between body image and physical activity in a sample of 277 British schoolchildren aged 11-14 years. However, in qualitative research with 11-15 year olds, Mulvihill *et al.* (2000) found that feeling embarrassed and self-conscious about the body was an important barrier to physical activity participation, especially among girls.

There has also been very little research examining the relationship between body dissatisfaction and physical activity, despite increasing concern about the prevalence of body dissatisfaction among girls and young women. Studies have shown that girls as young as 9 years old are unhappy with their body shapes (e.g. Hill *et al.*, 1994) and Maloney *et al.* (1989) found that half of 7-12 year old girls wanted to be thinner. Body dissatisfaction has been conceptualised as the discrepancy between the ideal and perceived (actual) self (Silberstein *et al.*, 1988), where the ideal self may be an 'internal ideal' or a 'societal ideal', the latter resulting from socio-cultural expectations concerning the perfect body (Champion & Furnham, 1999). According to self-discrepancy theory (Higgins, 1987), differences between the actual self and ideal self lead to negative emotional states, such as disappointment and dissatisfaction, which subsequently lead to decreases in motivation and self-efficacy for achieving bodily goals. This, in turn, may have a negative impact on the maintenance of healthy behaviours such as physical activity (Snyder, 1997; Anton *et al.*, 2000). In their review of correlates of physical activity among adolescent girls, Biddle *et al.* (2005) report that physical activity was consistently associated with more positive perceptions of one's body attractiveness. However, only three studies were identified, suggesting that further research is required in this area.

Perceived competence

Perceived competence is a subjective assessment of ability and is thought to play a key role in physical activity motivation (Fox & Corbin 1989; Biddle, 1997). According to Harter's *Competence Motivation Theory* (Harter, 1978), people with high perceived competence have higher expectations of success and achievement and therefore invest more effort and persistence in their pursuit of a specific behaviour. Specifically, higher perceptions of competence increase an individual's intrinsic motivation (Deci & Ryan, 1985). According to Deci & Ryan, intrinsically motivated behaviours are engaged in for their own sake and are associated with psychological wellbeing, interest, enjoyment and persistence (Deci & Ryan, 1985; Ryan & Deci, 2000).

Evidence suggests that higher perceptions of competence in the physical domain are associated with higher levels of physical activity. Among adolescents, Sallis *et al.* (2000) found that perceived competence was consistently associated with physical activity. Similarly, Biddle *et al.* (2005) found perceived competence to be positively associated with physical activity among adolescent girls, although effects were small. Among elementary schoolchildren (mean age 9.5 years), perceived competence was found to predict physical activity behaviour, and also mediated the relationship between the mother's perception of their child's competence and the child's physical activity (Bois *et al.*, 2005).

It is possible that perceptions of competence may be less important as a motivational construct in relation to lifestyle physical activity where there is less emphasis on skill and ability as compared with sport and exercise. For example, as mentioned earlier, Gilson *et al.* (2005) found that perceptions of sports competence were significantly associated with frequency of sport and exercise among boys but not with lifestyle physical activity. However, the reverse was true for girls: perceived sports competence was associated with increased lifestyle physical activity but not sports and exercise. The authors suggest this may have been due to low variability in sports and exercise participation among the female sample.

Understanding of the influence of competence perceptions on physical activity behaviour has been informed by the work of Nicholls and the development of Goal Perspectives Theory (Nicholls, 1978, 1989). According to this theory, individuals have different goals when engaging in achievement tasks. Two main types of achievement motivation have been identified and are described as 'ego' and 'task' orientation. Goal orientations are based on how competence is construed (Biddle & Mutrie, 2001) and therefore relate to personal definitions of success (Biddle, 1997). Perceptions of competence may be primarily self-referenced (task orientation) or may be derived through comparison with others (ego orientation). Individuals with high ego orientation tend to focus on ability, and success is defined in terms of demonstrating superiority in relation to others. Individuals with high task orientation focus primarily on self-improvement and successful completion of the task. Research suggests that high task orientation is associated with maintenance of involvement in physical activity over time and higher enjoyment of participation (Goudas *et al.*, 1994). In contrast, among those with high ego orientation, perceptions of competence are central to sustained involvement and therefore participation is likely to decline when perceived competence is threatened.

Work in this area has demonstrated the importance of developmental processes in children as they learn to distinguish between effort and ability and gain the cognitive capacity to make evaluative judgments of their own abilities, based on information from a variety of sources including peers and significant others. Fry (2001) argues that children are naturally task oriented until they develop a mature understanding of ability and are able to distinguish effort from ability and judge the difficulty of a task in normative terms. There is evidence to suggest that *perceptions* of one's own physical ability may be more important than actual ability (e.g. Sonstroem, 1978). For example, in relation to physical fitness, Fox (1988) argues that educators should focus on developing a sense of fitness competence in children rather than focusing solely on fitness as an outcome. He suggests that this may be best achieved through a greater emphasis on self-improvement and mastery goals rather than ego-oriented goals which encourage comparison with others. As stated by Fry (2001, p.73), "*children who perceive that they are low skilled and have little control over their sport performances are at risk of demonstrating maladaptive responses, including a preference for low challenges and higher anxiety.*"

Unlike other components of physical self concept, perceptions of sports competence have been found to remain relatively stable during adolescence (Maiano *et al.,* 2004). This suggests the need for early intervention to establish positive perceptions of sports competence among children at an early age.

Self-efficacy

Self-efficacy beliefs are central to human functioning, achievement and well-being. They can affect life choices, levels of motivation, resilience to adversity and vulnerability to stress (Bandura, 1994). Unless people believe that their actions can produce the outcomes they desire, they have little incentive to act or to persevere in the face of difficulties (Pajares, 2007). Much of the original work on self-efficacy was developed by Albert Bandura within the context of social cognitive theory. He defined self-efficacy as: "*people's judgements of their capabilities to organise and execute courses of action required to attain designated types of performances. It is concerned not with the skills one has but with judgements of what one can do with whatever skills one possesses*" (Bandura, 1986 p.391). It deals with cognitions of confidence, competence and capability, based on both past experience and other sources of information (Allison *et al.*, 1999a).

Self-efficacy is central to several health behaviour theories (see Chapter 3). It is also closely linked to the concept of intention because an individual is more likely to intend to be physically active if they believe they have the capability to do so (Kohl & Hobbs, 1998). Self-efficacy expectations not only influence behaviour but are in turn influenced by the success of the behaviour (Sonstroem & Morgan, 1989).

People with a high self-efficacy are more likely to approach difficult tasks as challenges to be mastered rather than as threats to be avoided. They expend greater effort in undertaking tasks and persist with their efforts even in the face of failure. Conversely, those with low self-efficacy generally have lower aspirations and readily give up in the face of difficulties. Failure is attributed to personal deficiencies. Self-efficacy changes throughout the lifecourse, with different stages of development presenting different competency demands. While initial efficacy experiences take place within the family context, as children move into adolescence, peers and schools have increasing influence. According to Bandura (1994), there are four main sources of influence on efficacy beliefs: mastery experiences, social modelling, social persuasion, and an individual's judgement of their somatic and emotional reaction to a specific task. Of these, mastery experiences, whereby one's success is measured in terms of self-improvement, is considered the most effective way of creating a strong sense of efficacy. All of the above, however, can act as negative as well as positive influences.

Self-efficacy is a situation-specific construct, such that different dimensions are relevant for different types of action or behaviour. 'Exercise self-efficacy' is commonly used to describe self-efficacy in the physical activity, sport or exercise domain. It has consistently been identified as an important predictor of physical activity among adults (Allison *et al.*, 1999a). A number of studies have also demonstrated the importance of self-efficacy among children and adolescents. For example, Reynolds *et al.* 1990 found that self-efficacy predicted weekly physical activity participation among adolescents. Among high school students in the USA, Allison *et al.* (1999a) found a positive relationship between exercise self-efficacy and participation in vigorous physical activity both in school (non-PE) and outside of school. In a review of correlates of physical activity among adolescent girls, a consistent small to moderate association between self-efficacy and physical activity was found (Biddle *et al.,* 2005). Also in adolescent girls, Dishman *et al.* (2004) demonstrated that self-efficacy mediated the effect of an intervention to increase physical activity, suggesting that future interventions designed to increase physical activity amongst this group should specifically target self-efficacy.

4.3 Attitudes towards physical activity

Enjoyment

"*We should resurrect 'joy' as a legitimate construct and restore affect and emotion to its rightful place, as central to an understanding of behaviour*"
(Harter, 1981a, p.4)

Enjoyment has been described as "*a positive affective state that reflects feelings such as pleasure, liking and fun*" (Motl *et al.,* 2001 p.110). Evidence suggests that enjoyment is a critical factor in physical activity participation and it is considered to be a core element of intrinsic motivation. However, Scanlan & Simons (1992) argue that enjoyment and intrinsic motivation are not synonymous, with enjoyment being a broader and more inclusive construct. Enjoyment can be derived from a range of external and internal sources, and may occur within both achievement and non-achievement contexts. Therefore, an activity can be enjoyable without being intrinsically motivating.

Despite this, research has shown that enjoyment often has important motivational consequences. Among children and adolescents, studies have shown that enjoyment is a major reason for taking part in physical activity. For example, among a sample of 5^{th} and 6^{th} grade US schoolchildren (mean age 11.2 years), DiLorenzo *et al.* (1998) found that enjoyment of physical activity appeared to be the most important predictor of physical activity levels, especially for girls. It is likely that the immediate feelings associated with physical activity are more important in relation to participation than longer-term benefits such as improved health outcomes. This may be especially true of young people for whom longer term health outcomes are too far removed from their everyday reality to provide a major incentive for involvement.

Surprisingly, Sallis *et al.* (2000) reported that there was no evidence for an association between enjoyment and physical activity among adolescents aged 13-18 years. They identified five studies of which none showed a significant relationship. However, a more recent review found that enjoyment consistently showed a small to moderate positive association with physical activity among adolescent girls, aged 10-18 years (Biddle *et al.*, 2005). Conflicting findings may, in part, be due to a lack of construct definition and methodological inconsistencies.

Evidence from qualitative research supports the centrality of enjoyment in physical activity motivation and participation among children and adolescents. Among young people, aged 11-15 years, in England, enjoyment was identified as one of three main reasons for taking part in physical activity (Mulvihill *et al.*, 2000). A study of high school students' attitudes towards physical education in New Zealand found that 'fun' was perceived to be a major benefit of physical activity and that this was a product of the social aspects of participation, i.e. spending time with friends (Hohepa *et al.*, 2006). Enjoyable PE experiences are considered important for fostering positive attitudes towards, and encouraging participation in, PE and physical activity (Prochaska *et al.*, 2003).

Research undertaken to identify sources of enjoyment reveals a wide range of intrinsic and extrinsic factors. These include, for example, development of personal skills, the use of skills, competition and comparison of skills with others, personal accomplishment and recognition of achievement, friendship, sense of belonging (to a team), prestige and reward, pleasing others, excitement and emotional release (Scanlan & Simons, 1992). Perceived competence has consistently been identified as a key factor in the enjoyment of sport and remaining committed to sport involvement (McCarthy *et al.*, 2008). Biddle (1993) argues that, from a psychological perspective, enjoyment should also be considered as an important outcome of physical activity in order to enhance motivation for future participation. Indeed, enjoyment provides immediate reinforcement for being physically active and may therefore be particularly important in the maintenance of physical activity (Motl *et al.,* 2001).

Intention

Intention is considered by many contemporary social cognitive theories as the most proximal determinant of action (Chatzisarantis *et al.*, 1997). As such, it has been argued that any attempt to change behaviour must first change the intentions of an individual towards that behaviour (Godin & Shephard, 1986). It has consistently been identified as a strong predictor of exercise behaviour among adults (Biddle & Mutrie, 2001). Similarly, Sallis *et al.* (2000) found that intention to be active was consistently positively associated with physical activity in both children and adolescents. Age and gender differences in physical activity intentions have been reported. For example, Mummery *et al.* (2000) found that younger children had higher intentions than older children and Bungum *et al.* (2000) found that intentions to be active were higher among boys than girls.

Intention is central to the Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980) which proposes that an individual's attitudes and perception of social norms toward a behaviour determine their intention to perform that behaviour. In turn, intention is believed to directly influence behaviour. Support for the TRA, and the importance of intention as a predictor of physical activity, has been demonstrated in children and adolescents (e.g. Mummery *et al.*, 2000; Reynolds *et al.*, 1990). Hagger *et al.* (2001) found that attitudes and self-efficacy were strong predictors of intention among early adolescents and that intention was also associated with past behaviour. This is in agreement with previous findings by Godin & Shephard (1986) concerning the importance of prior behaviour to physical activity intentions, suggesting that early socialisation into physical activity may be important for maintenance of physical activity participation.

Perceived benefits and perceived barriers

Perceived benefits and perceived barriers are core elements of the Health Belief Model (Rosenstock, 1974) and refer to an individual's beliefs about the positive and negative consequences of taking (or not taking) action (see Chapter 3). Qualitative research provides insights into the perceived benefits of taking part in physical activity. Among 11-15 year olds, Mulvihill *et al.* (2000) identified three key factors: improved feeling of wellbeing, enjoyment, and weight control. These findings were echoed in a recent review of participation in sport (Sport England, 2005) which found that concerns about body shape were the main reason for participation among young girls, but that enjoyment and social interaction with friends were also important.

There are conflicting findings about the importance of health beliefs in predicting physical activity behaviour. Among high school students, Zakarian *et al.* 1994 found perceived benefits to be positively correlated with exercise participation. However, Neumark-Sztainer *et al.* (2003) found that perceived benefits were not associated with change in physical activity over time among a sample of adolescent girls. In their review of correlates, Sallis *et al.* (2000) found no evidence for an association among children, and inconsistent results among adolescents, with only 11 out of 29 studies reporting a positive association. However, some inconsistencies may relate to the type of physical activity being investigated. For example, among adults, early evidence suggested that knowledge of the health benefits of physical activity was associated with lifestyle activity but not fitness-related exercise (Dishman *et al.*, 1985). Furthermore, beliefs about the positive benefits of physical activity may promote initiation, but not maintenance, of participation:

"*Knowledge of and belief in the health benefits of physical activity may motivate initial involvement, but feelings of enjoyment and well-being seem to be stronger motives for continued participation...*" (Dishman *et al.*1985 p.162)

According to the Health Belief Model, perceived barriers decrease the likelihood of engaging in preventive health behaviour, particularly if the perceived barriers outweigh perceived benefits. Since the model was first introduced, perceived barriers have been found to be one of the most consistent predictors of a wide range of health behaviours. In relation to physical activity, perceived barriers are associated with exercise self-efficacy, intentions and physical activity behaviour (Allison *et al.*, 1999b). Sallis *et al.* (2000) found perceived barriers to be negatively associated with physical activity in children. Among adolescents, however, findings were inconclusive.

Perceived barriers may be defined as perceptions of blocks, hurdles or constraints which are anticipated in undertaking a health-promoting behaviour (Garcia *et al.*, 1998). Some researchers have made a distinction between *external* barriers, such as social and environmental influences, and *internal* barriers, such as psychological factors (Allison *et al.*, 1999b). Understanding barriers to physical activity is important from a public health perspective as they may form the basis for targeted intervention strategies.

A number of studies have identified specific barriers to physical activity among children and adolescents. Among a group of 236 US adolescents, the most common barriers to exercise were wanting to do other things with their time, lack of interest, unsuitable weather and school work (Tappe *et al.*, 1989). Allison *et al.* (1999b) explored perceived barriers among 1041 Canadian high school students and found lack of time to be the most important barrier, especially due to school work, other interests and family activities. Among adolescent girls, Neumark-Sztainer *et al.* (2003) also found time constraints to be one of the strongest and most consistent factors (negatively) associated with change in physical activity over time.

Mulvihill and colleagues (2000) undertook qualitative interviews with 11-15 year olds in England and identified a number of key barriers to involvement in physical activity. These included: a sense of general inertia especially among older girls; a preference for non-physical activities; feelings of self-consciousness about their bodies (especially older girls); lack of time particularly due to the demands of homework; and financial costs including travel and costs associated with the activity itself. There is also evidence to suggest that perceived barriers vary by gender, with females more likely to report higher barriers to being active than males (Allison *et al.*, 1999b).

4.4 Summary

The transition from childhood to adolescence is characterised by psychological adaptation to the major biological and social changes which occur at this time. Young people's self-perceptions are especially vulnerable during this period, and changes in perceptions of the self are likely to have a significant impact on motivation and behaviour. In relation to physical activity, studies have shown that self-perceptions in the physical domain are important and more relevant than global measures of self concept. There is a relatively large literature exploring psychological correlates of physical activity, particularly within the context of established theoretical frameworks such as the Theories of Reasoned Action / Planned Behaviour and Social Learning Theory. Constructs such as intention, self-efficacy, competence and attitudes are central to these theories and there is increasing evidence to support their importance in predicting physical activity behaviour among children and adolescents. Some findings are inconsistent but it is likely that this is due to methodological issues such as differences in the conceptualisation and measurement of constructs.

Perceived barriers to physical activity are important to identify from an intervention perspective. In general, studies suggest that lack of time, lack of interest / preferring other activities and having too much schoolwork are important barriers among adolescents. There is also evidence that, for girls in particular, concerns relating to body consciousness are significant, although there is currently a lack of quantitative evidence in this area. Age and gender differences have been found for a number of psychological factors, with boys and younger children typically reporting more favourable psychological profiles.

Chapter 5

Social influences on physical activity

"It has been argued that the choice between physical activity or inactivity is not a question of physical capacity, but rather a question of a person's cultural and social upbringing and the need to show others who he or she is"
(Oygard & Anderssen, 1998, p.60)

5.1 Introduction

Health is a complex, social phenomenon. Most health outcomes and behaviours are socially distributed within society (Haughton McNeill *et al.*, 2006). Social stratification can lead to differential levels of exposure to health risks and differential degrees of individual or collective vulnerability in terms of health conditions and resources (Commission on Social Determinants of Heath, 2007). The concept of 'social determinants of health' is used to refer both to social factors which may promote or undermine the health of individuals, but also to the social processes which affect the distribution of health within a population. At an individual level, socialisation processes, social integration, the quality of interpersonal relationships and social support are associated with health behaviours and wellbeing. At a population level, patterns of social cohesion and social capital are also related to a range of health outcomes (Pellmar *et al.*, 2002).

A thorough review of the social determinants literature is beyond the scope of this thesis. Rather, this chapter focuses specifically on social factors which may impact on physical activity behaviour. It has been argued that sports participation is heavily influenced by the social world young people inhabit (Coakley & White, 1992). The social environment may influence behaviour in a number of ways, through both interpersonal processes, such as socialisation and social support, and family characteristics, such as family structure and social status. Among children and adolescents, gaining social acceptance and support – from peers and significant adults – is considered key to initiating and continuing physical activity participation (Weiss, 2000). Social influences on adolescents' physical activity are reviewed below and evidence is presented in relation to those factors which are considered pertinent to the present study. Relevant aspects of the social environment at the community level, specifically neighbourhood characteristics, will be discussed in Chapter 6.

5.2 Socialisation and the role of significant others

Early work on social determinants of physical activity was largely focused on sports participation. The most dominant theoretical framework used for researching social influences on sport and physical activity participation is socialisation theory. An early model of sports socialisation theory was proposed by Kenyon (1970) whereby personal attributes, significant others (socialising agents) and socialising situations were predictors of sports participation. A key criticism of early theoretical approaches, however, was that the individual was portrayed as passive within the socialisation process (e.g. Gouldner, 1970; Giddens, 1978). More recent approaches to socialisation theory, informed by Bandura's social learning perspective (Bandura, 1977), emphasise the interaction between an individual and the social system within which they operate. Socialisation is considered to be a reciprocal and dynamic process, defined as "*the process whereby individuals learn skills, traits, values, attitudes, norms and knowledge associated with the performance of present or anticipated social roles*" (McPherson & Brown, 1988, p.267).

Socialisation theory has been used to enhance understanding about how habitual physical activity can be adopted, maintained or discontinued (Wold *et al.*, 1994). Traditionally, socialisation into physical activity is viewed as a modelling process whereby significant others act as powerful role models for children as they grow and develop. In this context, a 'significant other' is an individual who, by word or example, has a major influence over the attitudes and behaviour of the child (Greendorfer & Lewko, 1978). Social modelling is a key process in which social behaviour is learned through the observation of significant others (Bandura, 1977). Role modelling may influence behaviour in two main ways: directly through imitation of the modelled behaviour or indirectly through social reinforcement, i.e. the adoption of the values of another which in turn affects behaviour (Wold & Anderssen, 1992). The importance of parental achievement beliefs and values in shaping their children's motivation-related cognitions (e.g. perceived competence, value of involvement) are emphasised in the expectancy-value model (Eccles and Harold, 1991). According to this model, parents who expect that their children can be successful in physical activity, and who value success in this area, will be more likely to influence their children to participate in physical activity. Research indicates that socialisation into sport and physical activity may also function through, for example, social norms, attitudes, verbal encouragement, emotional support and provision of practical support, such as transportation and resources (money and equipment).

Key socialisation agents include family members, peers and school. There is consistent evidence to support the importance of family members and friends in influencing the behaviour of children and adolescents. The family is considered a primary agent of socialisation. According to Kay (2004, p.40), "*family is particularly significant as a conduit for primary socialisation, the initial process through which children come to define their own identity and learn the rules and norms of the society in which they are part.*" There is evidence to suggest that children whose families participate in sport are more likely to take part themselves and that parents are particularly influential during early and middle childhood. The role of specific social influences, however, appears to vary by gender as well as by age:

"*Socialization in the family unit exerts a tremendous influence on health-related behaviours such as exercise. The relative importance of determinants seems to differ for girls and boys and the pattern of these determinants appears to change over time.*" (DiLorenzo *et al.*, 1998, p.470)

It is important to recognise that social interactions are reciprocal and dynamic in nature. According to Hasbrook (1986), this has often been neglected in studies of childhood socialisation into sport whereby relationships are generally assumed to be unidirectional with the child as the 'recipient' of the socialisation process. More recent models of child development recognise the complexity of family interactions and the reciprocal nature of parent-child relationships (Iannotti *et al.*, 2005). In reality, therefore, the process of sport socialisation may be bi-directional with children able to exert influence over the behaviour of their parents (or other socialising agent) as well as vice versa.

The extent of influence and potential effect mechanisms of different socialisation agents, including parents, siblings and peers, on child and adolescent physical activity will be considered in the following sections. In addition, the research evidence for the role of other social factors, such as social status and family structure, will be reviewed.

The influence of parents

Parents have a crucial role in the health behaviour of their children. This was one of the major conclusions from a series of systematic reviews on environmental correlates and interventions for nutrition and physical activity (Brug *et al.*, 2006). Parental influence on their children's physical activity behaviour may exert itself through role modelling, encouragement, practical support and transfer of values and beliefs. Evidence from research studies has consistently demonstrated the importance of parents as socialising agents in influencing their children's participation in sports and physical activity. According to Gottlieb and Chen (1985, p.533), "*primary socialization in the family unit is one of the major influences on [lifestyle health] behaviour patterns, which are formed early in childhood.*" Not surprisingly, research indicates that, the younger the child, the more influential the parents are (Sallis, 1994).

Many studies have explored the relationship between parental physical activity and their children's physical activity, but evidence is mixed. Traditionally, the relationship between parental and child physical activity has been based primarily on the theory that parents act as role models for their children. Role modelling may act in two ways: through *imitation,* i.e. direct copying of parental behaviour, or through *social reinforcement,* whereby the values of the parent are adopted by the child and in turn affect behaviour. Gottlieb and Chen (1985) found a strong relationship between parental exercise and sports participation in US children aged 11-12 years. Using both accelerometers and self-report methods among a small sample of 30 children aged 5-9 years old and their parents, Freedson & Evenson (1991) found that children displayed similar physical activity patterns to those of their parents. Children of high active parents were more likely to be highly active and children of low active parents were more likely to be low active themselves. Among Australian children, Cleland *et al.* (2005) report that parental exercise was positively associated with children's participation in extra-curricular sports and their cardiorespiratory fitness.

However, not all studies have shown a positive association between parental and child physical activity. In their review of correlates of physical activity in children and adolescents, Sallis *et al.* (2000) found mixed evidence. Only 11 out of 29 studies of children and 9 out of 27 studies of adolescents showed a positive association between parental and child physical activity. Differing results are particularly apparent in research which has investigated the role of mothers and fathers separately. Contrary to earlier hypotheses which suggested that same-sex parents had greater influence than opposite-sex parents on child sport involvement (e.g. Snyder & Spreitzer, 1973), more recent evidence indicates that fathers, but not mothers, may play a key role in the socialisation process by acting as role models for their children, both boys and girls. For example, Greendorfer and Lewko (1978) investigated the role of parents and siblings in relation to the sport participation of 8-13 year olds and found only fathers to have a significant influence. Similarly, Rossow & Rise (1994) found that fathers', but not mothers', physical activity was positively associated with adolescents' physical activity. Raudsepp & Viira (2000a) also found that levels of physical activity among 13-14 year old boys were significantly related to their fathers', but not their mothers', physical activity. However, among same-age girls, levels of physical activity were significantly related to both their fathers' and mothers' physical activity.

More recently, Iannotti *et al.* (2005) examined cross-sectional and longitudinal associations between mothers' and children's physical activity in a sample of US families taking part in the San Diego Study of Children's Activity and Nutrition. They found little evidence for a direct causal relationship between maternal and child physical activity. In addition, there were few significant concurrent associations, suggesting that maternal role modelling does not influence their children's physical activity. Fathers were not included in the study and therefore it is not possible from their data to compare the influence of mothers with that of fathers. In the absence of a role modelling effect, Iannotti and colleagues offer a number of alternative mechanisms which may provide a link between parental and child physical activity behaviour. These include:

- Genetic similarities.
- Indirect influence through shared environments, especially common location, resources and rules within the home environment.
- Parental attitudes, especially the extent to which physical activity is a valued behaviour.

Indeed, there is evidence to suggest that parents can influence their children's physical activity behaviour through a range of other mechanisms. Several studies report that child physical activity is more strongly associated with parental attitudes and values towards physical activity than with actual parent physical activity (Iannotti *et al.*, 2005). Parental attitudes and values may be passed on directly to the child and are also likely to affect the extent to which parents provide emotional and practical support for physical activity in their children. Direct parental support can be an effective strategy in promoting their children's physical activity. Sallis *et al.* (2000) found parental support to be consistently related to adolescent physical activity. Participating in joint activities with their children (Stucky-Ropp & DiLorenzo, 1993), organising activities for their children (Anderssen & Wold, 1992) and transporting children to places where they can be active (Sallis *et al.*, 1992) are all important means of providing parental support. A family's ability to provide practical resources to support their children's physical activity may vary, however, and therefore some children may be disadvantaged in this respect. Indeed, the family also plays an important role in social class differentiation in sport (Kay, 2004). This effect may be exerted through practical issues, such as living in areas with poorer access to facilities, or through attitudes and values, for example, differences in the way in which families view the developmental role of physical activity or the constructive use of leisure time.

The influence of siblings

As part of the family unit, siblings, and particularly older siblings, may also be an important socialisation agent, yet fewer studies have been undertaken to examine their influence on physical activity behaviour. Sallis *et al.* (2000) reported that sibling physical activity is consistently associated with adolescents' physical activity, but this conclusion was based on only four studies. Among Icelandic adolescents, aged 15-16 years, Vilhjalmsson and Thorlindsson (1998) found that older brothers' physical activity was positively related to physical activity levels among both boys and girls. Older sisters' physical activity, however, was not. Raudsepp and Viira (2000b) investigated the influence of sibling physical activity among Estonian adolescents aged 13-14 years. They found that brothers' physical activity was significantly associated with physical activity among boys and girls, but sisters' physical activity was associated with physical activity among girls only. These findings suggest that brothers may have a more important role than sisters in supporting physical activity behaviour among their younger siblings.

More recently, Duncan *et al.* (2004) investigated the degree of homogeneity in physical activity among siblings using multilevel analyses. The research was undertaken in the USA among families with 10-, 12- or 14-year old children. They found significant homogeneity within families and heterogeneity between families. The findings indicate that siblings tend to have similar physical activity habits and that these may, in part, be influenced by factors such as levels of support for physical activity from other members of the family.

The influence of peers

> *"For adolescents, the influence of peers is paramount. If a given adolescent identifies with a peer group that values and participates in physical activity, the group creates a supportive environment for its members. If the main peer group devalues physical activity, this is an effective deterrent."*
> (Sallis, 1994, p.4)

During adolescence, peers have a particularly important role in relation to the development of behavioural patterns and identity formation. Peer relationships are considered central to early adolescents' motivation in achievement domains such as sport and physical activity (Smith, 1999). Peer acceptance and close friendships are critical aspects of peer relationships and interactions (Weiss, 2000). Peer acceptance relates to one's status or popularity within the peer group, whereas friendship encompasses interactive characteristics of the relationship such as quality and supportive functions (Smith, 1999). Many children take part in physical activities with their friends. Indeed, physical activity settings, such as sports clubs, school and the local neighbourhood, all provide opportunities for peer interaction. As a result, peer groups provide an important context for youth development within which attitudes and behaviours may be shaped. According to Wold *et al.* (1994), peer influence on physical activity can function in a number of ways:

- Children encourage each other to take part.
- Children may take part because friends already do so.
- Friendships are established through taking part.

Peers also provide an important source of competence information and contribute to enjoyment of physical activity through recognition of accomplishments, companionship and esteem support (Smith, 1999). In relation to peer acceptance, studies suggest that physical competence is highly valued among young people (e.g. Adler *et al.*, 1992; Weiss & Duncan, 1992). Friendship is believed to influence participation through engendering positive affective responses to physical activity. There is evidence that having close friends who are physically active is associated with more positive attitudes and experiences of physical activity among young people. Among 12-15 year olds in the USA, Smith (1999) found that boys' and girls' perceptions of close friendship in the physical domain were directly associated with positive attitudes towards physical activity and indirectly associated with motivation to be active. In addition, girls who reported having a close friend in sport or physical activity were more physically active. Perceptions of friendship and peer acceptance were found to be independently associated with physical activity motivation, and both therefore appear to contribute towards the formation of physical activity attitudes and behaviours. Friendship may play a particularly important role in girls' physical activity participation; studies suggest that having a same-sex friend with whom to participate is a key factor in girls' engagement (Bailey *et al.*, 2005; Flintoff & Scraton, 2001).

Previous research has found that adolescent exercise levels are associated with those of their peers (e.g. Anderssen & Wold, 1992; Sisjord, 1993). Among Estonian adolescents aged 13-15 years, Raudsepp & Viira (2000a) found that the physical activity level of a young person's best friend was significantly related to moderate and vigorous physical activity among boys, and to vigorous activity only among girls. Among Norwegian adolescents, Wold *et al.* (1994) found that the strongest correlate of children's vigorous physical activity was their best friend's physical activity. Vilhjamsson & Thorlindsson (1998) explored the relationship between best friend's physical activity and the level of emotional support provided by that friend. They found a significant interaction between these two factors, suggesting (as might be expected) that a friend's behaviour is more influential when the friendship is emotionally close.

There is evidence to suggest that the role of peers becomes more important as children get older and the influence of parents declines. For example, Godin & Shephard (1986) found a shift in strength of influence from parents to peers as children moved from 7^{th} to 9^{th} grade (approximately 11-14 years). Similarly, Wold *et al.* (1992) found that the sports participation of peers was positively associated with adolescents' own participation in sports and that the influence of peers was stronger than that of family. The effect of social influences may also vary according to the type of physical activity. For example, Dishman *et al.* (1985) found that children's physical activity participation outside of structured programmes was influenced more by peers than family.

However, the way in which peers may influence adolescent physical activity behaviour is still not fully understood. In an earlier review of determinants of physical activity in 3-12 year olds, Taylor and Sallis (1997) concluded that support from peers was positively associated with behaviour, although this was based on the findings from only two studies. In their more recent review, Sallis and colleagues reported no association between peer influences and physical activity among children, and concluded that peer modelling is not related to adolescent physical activity. Findings in relation to the role of peer support among adolescents were inconsistent, with only two out of five studies showing a positive effect (Sallis *et al.*, 2000).

This suggests a need for further exploration of the processes by which peer group culture may impact on physical activity. In addition, it is possible that peer relationships are of particular significance at certain stages of adolescent development. As stated by Smith (2003, p.34)), "*a better understanding of youth peer relationships might allow insight into important developmental and career transitions of relevance to physical activity involvement.*" For example, the transition from primary to secondary school is a stage at which many young people, especially girls, become less active. The extent to which peer relationships and continuity of relationships may impact on physical activity motivation and behaviour during this transitional period is, as yet, unclear.

5.3 Gender differences in socialisation

Research has shown clear patterns of differentiation in physical activity participation by gender among both adults and adolescents. There is evidence to suggest that this may, in part, by explained by different socialisation processes for sport and physical activity among boys and girls. Gender analyses of sport, particularly from a feminist perspective, have clearly shown the differential influence of the family on girls' and boys' attitudes to, and engagement in, sport and physical activity (Kay, 2004). Greendorfer and Lewko (1978) argue that parents tend to respond to males and females in a sex-stereotypic fashion in the area of play and games, with males being more encouraged to participate in active pursuits outside the home, while girls are more encouraged to engage in domestic activities within the home. Sex-stereotyping of sport and physical activity as masculine is likely to lead to higher levels of parental support and reinforcement for boys than girls, creating social barriers to participation among girls from an early age. According to Kay (2004, p.41), "*research into the very early play activities of young children has shown that parents adopt gendered practices towards girl and boy children from the very earliest hours of their lives, contributing to a deeply-rooted set of gender expectations that pose obstacles to many girls' sports involvement in later years.*"

Research findings support the notion that parental influence may differ for boys and girls. Among US children (mean age 10 years), Brustad (1993) found that boys received more encouragement to be active from their parents than girls did. Furthermore, parental encouragement was positively associated with higher perceived competence and perceived competence itself predicted children's attraction to physical activity. In their study of 11-12 year olds in the US, Gottlieb and Chen (1985) found that parental exercise had a greater effect on girls than boys. They suggest that, because western cultures are more supportive of sport and exercise for males (sport is perceived as masculine, higher prevalence of male role models, greater reinforcement for males), parental modelling may be especially important for girls.

There is also evidence that positive peer influences may be more available to boys than girls (Kohl & Hobbs, 1998). For example, Coakley & White (1992) found that social support and constraints from friends toward physical activity participation differed for female and male adolescents. Attitudinal differences may also contribute towards gender variations in sport and physical activity (Vilhjalmsson & Kristjansdottir, 2003). For example, studies have found that sport is closely associated with masculine identities (e.g. Lantz & Schroeder, 1999) and that boys value achievement in sport more highly than girls (e.g. Whitehead *et al.*, 1997). Among Icelandic adolescents, Vilhjalmsson & Kristjansdottir (2003) found that lower enrolment of girls in organised sports clubs accounted for gender differences in overall physical activity. While girls may choose not to participate in organised sports clubs, such findings may also reflect wider structural barriers to participation among girls in terms of availability and enrolment opportunities.

5.4 Social position and physical activity

A number of studies provide evidence for a relationship between social position and physical activity. Social position may be operationalised in terms of income, education, occupation or class. The family plays a key role in social class differentiation in sport and physical activity (Kay, 2004) and a direct link between family social status and adolescent physical activity is believed to exist (Kantomaa *et al.*, 2007). Factors such as low income, lack of private transport and living in neighbourhoods with fewer high quality facilities are all likely to contribute towards social differentiation (Kay, 2004). The relationship between socio-economic status and physical activity in children and adolescents has been discussed previously in Chapter 2 and evidence is mixed. However, social inequalities in health-related behaviours are influenced not just by material factors such as income. Bourdieu (1978, 1984, 1985) argues that the influence of social position on health behaviour functions through both *economic capital* (wealth) and *cultural capital* (education) and that, in the field of health behaviour, cultural capital is the most important. Indeed, among adolescents, those with highly educated parents have been found to be more active than those with less educated parents (Taks *et al.* 1993). Furthermore, a study of Finnish adolescents found that parental education was a stronger predictor of adolescent physical activity than family income (Kantomaa *et al.*, 2007). Bourdieu (1978, 1984) explains the relationship between education and physical activity in terms of people's perceptions of the body and the value that is attached to different types of bodily form, such as 'healthy', 'fit' or 'slim'. The interplay of education and lifestyle during childhood and adolescence may itself reinforce social differentiation, and subsequent health inequalities, in later life.

5.5 Social norms and physical activity

It is also likely that social norms are reproduced from one generation to the next. Thus, differentiation may result from differing cultural expectations, attitudes and values, for example, in relation to the constructive use of leisure time, the developmental role of physical activity or the health benefits associated with an active lifestyle (Kay, 2004). The concept of subjective norms is central to the Theory of Reasoned Action (Ajzen & Fishbein, 1980) and relates to the influence of significant others on one's behaviour. The extent to which significant others believe that a behaviour is important, and the degree to which their opinions are valued, are believed to influence the likelihood of an individual performing that behaviour. In a sample of 520 13-17 year olds, Bungum *et al.* (2000) found that subjective norms were significantly associated with vigorous physical activity in girls and with intention to exercise in both girls and boys. However, there was no association between subjective norms and moderate physical activity in either girls or boys. Sallis *et al.* (2000) found no evidence for an association between subjective norms and children's physical activity and inconsistent findings for adolescent physical activity.

5.6 Family structure and physical activity

It is important not to treat family as a homogeneous entity. The concept of 'family' means different things to different people and children's experiences of family will vary greatly. Societal trends such as labour market restructuring, changing gender relations, and changing patterns of family formation, dissolution and re-formation (Kay, 2004) contribute to this diversity in family life and have implications for a range of health behaviours and health outcomes. These wider social changes affect family size, composition, income, working patterns and gender roles. Recent data from the Health Behaviour in School-aged Children (HBSC) study show that, among adolescents in Scotland, health outcomes are related to both family structure and to quality of parent-child communication within families (Todd *et al.*, 2007).

Adolescents living with both biological parents were less likely to report low life satisfaction, smoking or drunkenness than their peers in single parent or step families. However, research suggests that, while there are differences by family structure, the complex underlying processes and interactions between family members (Houseknecht & Hango, 2006), and the material disadvantage experienced by some family types (Spencer, 2005), may be more important.

Only a relatively small number of studies have explored the relationship between family structure and physical activity among children and adolescents and the findings are not conclusive. Bungum & Vincent (1997) found that girls who were nurtured by their biological father were more likely to be physically active. Lindquist *et al.* (1999) found that participation in vigorous exercise (days per week) was higher among children from single-parent households compared with those from two-parent households. No significant relationship between family structure and physical activity was found for reported hours per week of vigorous exercise, physical fitness (VO_{2max}) or sports team participation. However, the small sample size (n=107) and age range (6.5-13 years) make these findings difficult to interpret.

5.7 Summary

The social context in which young people live has an important influence on their health. Much of young people's physical activity takes place within a social context and therefore it is not surprising that social factors play an important role in determining physical activity behaviour among children and adolescents. Parents, siblings and peers are key influences, as is the wider socio-cultural context in which young people grow and learn. The family is identified as a primary agent in early socialisation experiences and parents in particular are believed to be one of the strongest socialising agents for children and adolescents. The socialisation process may function in a variety of ways, including: role modelling, social norms, the transmission of attitudes and values, direct encouragement, emotional support and practical support. Of these, current evidence suggests that parental encouragement and practical support may be particular important. In addition, research suggests that parental social status and family structure may also impact on physical activity participation.

As children get older, the role of parents decreases while that of peers increases. Close friendship and peer acceptance have both been identified as important mechanisms for the influence of the peer group on physical activity. Furthermore, evidence suggests that having friends who are physically active may be particularly important for girls. However, much of the research into social influences on physical activity is still inconclusive. For example, the relative importance of mothers and fathers as socialisation agents is, as yet, unclear. Further research is also required to determine the exact mechanisms by which parents and peers may influence children's physical activity.

Chapter 6

Environmental influences on physical activity

"Of the determinants of physical activity, environmental influences are the least understood but arguably the most important class of determinants that should be targeted through public health interventions." (Owen *et al.*, 2000, p.153)

6.1 Introduction

As stated by Diez-Roux (1998, p.216), "*in its origins, public health was essentially ecological, relating environmental and community characteristics to health and disease.*" During the 20th century, however, as chronic diseases became more prevalent and overtook infectious diseases as the primary cause of premature mortality, the focus shifted towards individual-level factors, in particular, behavioural and biological characteristics. Risk became increasingly individualised, with a move away from environmental determinants towards individual responsibility for health. However, there is now increasing interest in the role of environmental factors in health protection and health promotion. The importance of supportive environments for promoting health (re)emerged as a public health priority following the Ottawa Charter for Health Promotion (WHO, 1986) and has since been embedded in policy and practice through, for example, global initiatives such as health promoting schools, health promoting hospitals and healthy cities.

In relation to physical activity, environmental factors have the capacity to facilitate or hinder behaviour (Sallis & Owen, 1997) but have so far received the least attention in relation to physical activity in children and adolescents. This is now changing as recognition of their importance increases. From a public health perspective, environmental factors have the potential for greater impact as their effect reaches beyond individuals to whole populations. Not only do individual-level psychological and social variables explain only a limited proportion of the variance in physical activity behaviour (Sallis *et al.*, 2002a), but the effectiveness of individual-level interventions for physical activity is limited by the influence of the environment at a population level (Foster & Hillsdon, 2004; Hillsdon *et al.*, 2002). Drawing on a relatively recent but rapidly expanding evidence base, this chapter provides an overview of the role of the environment in supporting and promoting physical activity behaviour.

6.2 What is meant by 'the environment'?

In relation to physical activity, Foster & Hillsdon have defined the environment as "*any aspect of the physical (natural) environment or the urban or constructed environment that unconsciously or consciously relates to an individual and their health-enhancing physical activity*" (Foster & Hillsdon, 2004, p.756). The relationship between the physical environment and health is now a core strand in international public health policy. For example, providing a safe neighbourhood environment for children and young people as they grow and develop is identified as a key target within the World Health Organisation's European Strategy for Child and Adolescent Health and Development (WHO, 2005). For the purposes of this chapter, however, a broader definition will be used including both social and physical dimensions of the environments within which children and young people live and play. As noted by Frumkin (2003), the qualities of a place represent more than its physical features; place is also a social construct. Children themselves view the environment as a social space defined by social codes and expectations (Thomas & Thompson, 2004). Thus it is important to consider the social characteristics of neighbourhoods which may impact on the perceptions and behaviour of those who live there. In relation to physical activity, perceptions of safety and the degree of social cohesion within one's neighbourhood may be particularly relevant. A similar definition has been used previously by Davison & Lawson (2006) who argue that such social characteristics are often intimately linked with many physical environmental characteristics such as street lighting, the condition of buildings and the presence of litter or rubbish in an area.

6.3 The importance of the environment to physical activity

Providing children with opportunities to play freely outdoors and explore the natural environment is important for their development. However, there is evidence to suggest that such opportunities are under threat. Barriers to engagement with outdoor spaces include traffic & road safety concerns, fears of bullying, criminal threat and stranger danger, lack of investment, overcrowding and poverty (Thomas & Thompson, 2004). A number of other environmental factors are believed to have contributed to recent declines in physical activity within the general population, including:

- Increased car use
- Increases in energy-saving devices in public places, for example, lifts, escalators and automatic doors
- Increases in availability of sedentary leisure activities such as televisions, computers and the internet.

As a consequence of such societal changes, there has been renewed interest in the role of environment factors in determining behaviour. This interest is also underpinned by a socio-ecological perspective which recognises the role of multiple levels of influence on individual behaviour (see Chapter 3):

"Understanding the associations between physical activity and the neighbourhood environment has been the subject of recent international interest. This interest reflects a social ecological view of health and recognition of the interaction between individuals and their environment. Moreover, it has been suggested that predictions based on theory and the performance of interventions may be enhanced by considering the influence of "place" rather than by simply focusing on individuals." (Giles-Corti & Donovan, 2002a, p.601)

As a focus for intervention, the physical environment may hold considerable promise for affecting change at a population level but, potentially, this also introduces new challenges. Sallis *et al.* (2004) argue that effectively addressing the issue of physical inactivity through focusing on environmental variables will require collaboration between the health, planning and transportation sectors. Thus, progress in this area is likely to be dependent on effective multi-sectoral collaboration. Much can be learnt from the transportation and urban planning literatures to inform public health policies and interventions. For example, research in these areas has shown the effect of land use on choices about mode of travel. Only recently, as the health benefits of walking have become evident, have health researchers become more interested in this field. Several factors have been identified as affecting 'walkability' of an area, including higher population density, greater mixed land use and higher connectivity (Saelens *et al.*, 2003), and a number of studies have shown that neighbourhoods with high walkability are associated with higher reporting of regular walking and cycling (Sallis *et al.* 2004).

From a public health perspective, many planning and transport policies appear to run counter to health-related goals. For example, Frank and Engelke (2002) argue that the built environment is now designed primarily around car use at the expense of active transport options. Developments such as out-of-town business parks, shopping centres and recreational facilities reduce the opportunity for active transport by increasing the distance between where people live and where they work or spend their leisure time. Indeed, closer proximity of shops, workplaces and non-residential land to housing areas has been positively associated with walking and cycling behaviour (Cervero, 1996; Kockelman, 1997). Accordingly, a number of strategic documents at national and European level (WHO, 2006; Scottish Executive, 2003) highlight the need for more cross-cutting policy and joint planning across sectors including health, education, leisure and recreation, transport and planning.

6.4 Social and physical environmental correlates of physical activity behaviour

As this is a relatively new area within the field of physical activity research, especially among children and young people, it is useful to first make some reference to the adult literature in order to identify those features of the environment which may be relevant to physical activity behaviour. Among adults, access to local sports and recreational facilities (Sallis *et al*, 1989; Sallis *et al.*, 1990), presence and quality of pavements (Brownson *et al.*, 2001; De Bourdeaudhuij *et al.*, 2003; Addy *et al.*, 2004), availability of local shops and services (Duncan *et al.*, 2005), perceived attractiveness of the environment (Brownson *et al.*, 2001; Giles-Corti & Donovan, 2002b; Giles-Corti *et al.*, 2005a), the presence of street lighting (Addy *et al.*, 2004) and perceived safety (Foster *et al.*, 2004; Li *et al.*, 2005) have all been associated with increased physical activity, particularly walking and cycling. Population density has also been found to be consistently correlated with physical activity, with higher population density associated with increased activity. According to Owen *et al.* (2000), this association may be influenced by street layouts which facilitate walking and cycling for local journeys, safety concerns associated with high traffic volume in urban areas, and increased travel distances in more spread out suburban or rural areas.

Humpel *et al.* (2002) undertook a review of 16 studies which assessed the relationship between environmental variables and recreational physical activity in adults. They considered five categories of variables (accessibility of facilities, opportunities for activity, weather, safety, and aesthetic attributes) and concluded that access to recreational programmes and facilities and a neighbourhood's aesthetic qualities were associated with physical activity. Environmental factors have been found to account for between 4-13% of the variance in physical activity behaviour among adults (Duncan *et al.*, 2005; De Bourdeaudhuij *et al.*, 2003). In one Dutch study, environmental factors accounted for 19% of the variance in physical activity among children aged 6-11 years (De Vries *et al.*, 2007). Foster and Hillsdon (2004) conducted a systematic review of environmental interventions to increase health-enhancing physical activity. Seventeen studies met the inclusion criteria, of which three included changes to the physical environment to support physical activity. The remaining studies examined the impact of health education posters or banners on stair use. There was some evidence that a combination of changes to working practices, policies and the physical environment can increase fitness and active commuting among adults, and that environmental prompts have a positive effect on behaviour in the short-term. However, they argue that further observational studies are required to explore the nature of the relationship of the environment to health-enhancing physical activity behaviour.

As mentioned earlier, less research has been undertaken among children and adolescents, but sufficient evidence is emerging to allow consideration of certain aspects of the physical environment in relation to children and adolescents' physical activity behaviour. These include access to facilities and programmes, availability of equipment, perceived safety, time spent outdoors and neighbourhood characteristics. In this next section, the evidence base for the impact of these five distinct dimensions of the environment on children's and adolescents' physical activity will be discussed in turn.

Access to facilities and programmes

Among children and young people, it might be expected that availability of parks, play areas and recreational facilities within the local neighbourhood would be associated with increased physical activity. A number of studies lend support to this hypothesis. For example, among pre-school children, Sallis *et al.* (1993) found higher levels of physical activity among those who had places to play, such as parks, nearby. Among older children (aged 10-12 years), lack of availability of local parks has been negatively associated with walking and cycling (Timperio *et al.*, 2004). Cohen *et al.* (2006) found that adolescent girls who lived near parks were more active outside of school than those with fewer parks, particularly if those parks included amenities such as playgrounds, basketball courts, walking paths and swimming areas. Parks with streetlights and floodlights were also associated with increased non-school physical activity. In relation to vigorous physical activity, a study of high school students in New Zealand found that students who lived within walking distance of a park, skateboard ramp, sports field, swimming pool, gym or cycle track were significantly more active than those who did not (Utter *et al.*, 2006).

In contrast, de Vries *et al.* (2007) found no significant association between the presence of neighbourhood sports and recreation facilities and physical activity among 6-11 year olds, with the exception of sports fields. However, they did find positive associations with the proportion of greenspace, cycle tracks and a general rating of 'activity-friendliness'. In their review of correlates of physical activity behaviour, Sallis *et al.* (2000) found access to physical activity facilities and programmes was consistently associated with increased physical activity in children and having opportunities to exercise was associated with increased physical activity among adolescents. Differences in findings may be explained by the use of different methods to assess both local facilities and physical activity behaviour.

Children's perceptions of the physical environment have also been investigated using qualitative techniques. In one study, Australian children aged 10 years were asked to draw maps and take photographs to represent aspects of the home and neighbourhood environment which were important to them (Hume *et al.*, 2005). Opportunities for physical activity / sedentary pursuits and green space / outside areas were two of six key themes identified. Of these, opportunities for physical activity in the local neighbourhood were positively associated with physical activity among girls.

Availability of sports and games equipment at home

Availability of equipment for use in sport or physical activity has been studied less in relation to children and adolescents, although it would seem reasonable to suggest that this might be an important influence on participation in activities which require specific equipment. Trost *et al.* (1999) found that girls' access to sporting equipment in the home was significantly associated with objectively measured physical activity. However, in their review of correlates, Sallis and colleagues (Sallis *et al.*, 2000) concluded that there was no evidence to support an association between availability of equipment or supplies and physical activity in adolescents aged 13-18 years. Similarly, in a more recent review by Davison & Lawson (2006), four out of six studies showed no association between home equipment and children's physical activity. The other two studies (Fein *et al.*, 2004; Stucky-Ropp & DiLorenzo, 1993) reported higher levels of physical activity among adolescents who had more exercise equipment at home. According to Davison & Lawson, it is possible that these different findings may be explained by the ethnic composition of the samples (with positive associations found among predominantly white samples only) and / or the methods used to measure physical activity.

Perceptions of safety

Safety concerns, particularly parental concerns, have been identified as a major reason for increased restrictions on children's independent play compared with previous generations. High profile media coverage of child abductions is thought to have contributed to heightened concerns around stranger danger, and increasing car use has also had an impact on perceptions of road safety. In their study of walking and cycling among Australian children aged 5-6 years and 10-12 years, Timperio *et al.* (2004) identified stranger danger and road safety as the most common concerns among parents. Negative perceptions of the local neighbourhood among parents were generally associated with lower levels of walking or cycling among their children. Surprisingly, however, parental perceptions of heavy traffic in the local area were associated with higher levels of walking and cycling among children, but this may be due to the fact that parents of active children were more aware of road safety issues. It is possible that this could also reflect a SES effect, with heavy traffic and busier roads in less affluent neighbourhoods combined with low car ownership. Overall, Timperio and colleagues found that parental perceptions of the neighbourhood were more strongly related to children's walking and cycling behaviour than the child's own perceptions. This is probably a reflection of the degree of parental control over children of this age. Thus, parental attitudes towards the outdoor environment have an important influence on children's physical activity behaviour:

"Surveys suggest that the vast majority of children enjoy playing outside and would like to do so more. Yet, from a parental stance, our outdoor urban environments are often ridden with hazards such as stranger-danger, traffic speed, gangs and drugs. These issues affect parental licence on children's mobility and are particularly pronounced in more deprived neighbourhoods." (Coulson & Maudsely, 2007, p876)

Among older adolescents, it might be expected that the influence of parental perceptions would decrease as individual independence and autonomy increases. Indeed, findings by Hillman *et al.* (1990) support this notion. They carried out a study of levels of independent mobility and patterns of travel among schoolchildren aged 7-11 and 11-15 years in England. Considerable restrictions on children's independent mobility were found and were typically related to parental safety concerns. For example, among 7-11 year olds, only 37% were allowed to go on their own to places other than school and 35% were allowed to come home from school alone. Among 11-15 year olds, the percentages increased to 84% and 87% respectively. Restrictions were generally higher among girls than boys.

A qualitative study of children's attitudes towards their environments identified assessment of danger as children's top priority when thinking about different environments (Thomas & Thompson, 2004). Danger was often mentioned by children when discussing time spent away from the home. Concerns about danger related to a range of issues including traffic, strangers and criminals, bullying and being lost. Thus, it is clear that safety concerns relate to social as well as physical dimensions of the environment. In this respect, neighbourhood characteristics such as levels of social interaction or social disorder have been investigated. Molnar *et al.* (2004) found that lower neighbourhood safety and higher levels of social disorder were significantly associated with lower physical activity among US 11-16 year olds. Carver *et al.* (2005) report a positive association between perceptions of high social interaction within the neighbourhood and walking and cycling among adolescents aged 13 years. There is also evidence for a significant negative association between crime or area deprivation and physical activity among children (Davison & Lawson, 2006). Research findings, however, are still somewhat ambiguous. For example, based on data from 1992 Youth Risk Behavior Survey in the USA, Lee and Cubbin (2002) found no association between neighbourhood social disorganisation and vigorous physical activity in youth aged 12-21 years. However, it may be that vigorous activity is more likely to take place outside the immediate neighbourhood and therefore less likely to be directly associated with characteristics of that neighbourhood. Significant associations are more commonly found for activities such as walking and cycling which are more likely to take place locally.

Time spent outdoors

"There is now an emerging body of evidence that suggests that the local environment, and particularly natural environments, meets a wide range of human needs and promotes wellbeing." (New Economics Foundation, 2005, p.2)

Not all children have access to sports facilities or can afford to participate in organised sports activities. But outdoor spaces, including the natural and built environment, can provide a range of opportunities for play and physical activity. Access to the countryside and outdoor recreation is highlighted as an important element in efforts to promote physical activity in Scotland's national physical activity strategy (Scottish Executive, 2003). This reflects a renewed emphasis on engagement with the outdoors and increasing interest in the association between greenspace and health. While conclusive evidence is still lacking, a number of studies among adults provide evidence to support the notion that engagement with greenspace may be associated with health benefits (e.g. Maas *et al.*, 2006; Mitchell & Popham, 2007).

Among children, Fjortoft (2004) found that exposure to a natural landscape was associated with improved motor development. Restrictions on children's freedom to roam and explore outdoor spaces will inevitably impact on their overall levels of physical activity. Indeed, time spent outdoors has been found to be associated with observed physical activity in children (Klesges *et al.*, 1990) and there is evidence to suggest that it is the strongest correlate of children's physical activity (Sallis *et al.*, 2000; Taylor & Sallis, 1997). Qualitative studies have identified a number of barriers to engagement with outdoor spaces among children and adolescents. Davis & Jones (1996) undertook focus groups with 9-11 and 13-14 year olds to explore their ideas about transport, health and the local environment. Problems associated with parks and other public play areas included vandalism, glass and the presence of groups of older teenagers. Access to outdoor space has also been found to be more restricted among children from disadvantaged backgrounds compared with those from more affluent families (Thomas & Thompson, 2004).

Time spent outdoors is likely to be weather dependent and therefore subject to seasonal variation. Poor weather has been identified as a barrier to physical activity in children (Tappe *et al.,* 1989). Among adults, Uitenbroek (1993) found significantly lower rates of participation in leisure time physical activity during winter when compared with summer in Scotland. Among children, studies have found lower levels of physical activity associated with very hot weather (Baranowski *et al.,* 1993; Brodersen *et al.*, 2005) and with higher levels of rainfall (Brodersen *et al.*, 2005). Recently, Tucker and Gilliland (2007) reviewed the evidence for the effect of weather and season on physical activity and found that levels of physical activity vary with seasonality and that poor or extreme weather is a major barrier to participation. It is likely that the effects of weather on physical activity behaviour will be particularly acute where there is a lack of alternative indoor facilities (Davison & Lawson, 2006).

Neighbourhood characteristics

In their review of environmental correlates of physical activity among children, Davison & Lawson (2006) found support for a positive association between the presence and condition of pavements and children's physical activity, with three out of four identified studies showing a significant effect. In two studies, the presence of pavements was associated with an increased likelihood of children walking or cycling to school (Ewing *et al.*, 2004; Boarnet *et al.,* 2005). In a study of boys aged 10-14 years, Jago *et al.* (2005) investigated the influence of pavement characteristics - including location, material, streetlights and trees - and found these to be positively associated with light physical activity and negatively associated with sedentary behaviour. No association was found between pavement characteristics, ease of walking/cycling, tidiness and street access/condition and moderate-to-vigorous physical activity. Jago *et al.* (2006) further examined the associations between environmental features and physical activity by comparing observed, Geographical Information Systems (GIS) and self-reported measures of the environment with the same sample of early adolescent boys. Again, only pavement characteristics were associated with (light) physical activity. It may be that, among this sample of young males, MVPA is more likely to take place in sports or other recreational facilities located outside the area where they live. Thus, characteristics of the neighbourhood environment such as the condition of streets and pavements may be less relevant to this type of physical activity behaviour. This study had some other important limitations. Firstly, it included only boys and it is possible that environmental influences on behaviour may differ for girls. Secondly, physical activity was measured by accelerometer which provides an assessment of overall levels of physical activity. Giles-Corti *et al.* (2005b) argue that it is important to explore the influence of environmental characteristics on *context-specific* behaviours. Different types of physical activity behaviour will be associated with different settings, and generic measures of overall participation may therefore mask significant associations.

The aesthetic characteristics of the physical environment are also important to consider because they reflect qualitative aspects which are not necessarily captured when quantitative indicators are used. Having access to a park or recreational facility may be of no benefit if it is unattractive, vandalised or full of litter and broken glass. Such perceptions of quality may be highly relevant to physical activity behaviour. As mentioned earlier, there is evidence to suggest that aesthetic characteristics influence physical activity in adults, but very little work has been done in this area with children. Qualitative work, however, does suggest that children are concerned about the quality of their local environments. Children's negative perceptions of the environment were commonly associated with poor aesthetic characteristics such as the presence of litter, vandalism or neglect (Thomas & Thompson, 2004). In their recent review, Davison & Lawson (2006) identified only one study (Mota *et al.*, 2005) which investigated the influence of aesthetic characteristics of the neighbourhood on adolescents' physical activity. They found that positive aesthetic characteristics, such as the presence of interesting things to look at while walking, were associated with higher levels of physical activity.

6.5 Summary

In recent years, physical activity research has increasingly been guided by ecological approaches in recognition of the wide range of influences on physical activity behaviour and the limitations of individual-level interventions. Accordingly, the role of environmental factors has become a core area of interest. From a public health perspective, focusing on environmental interventions could hold considerable potential for influencing physical activity at a population level. It is clear from the adult literature that the environment in which people live can have a significant effect on physical activity levels. While less research has been undertaken with children and adolescents, and one cannot assume that the associations observed among adults are applicable to children, emerging evidence suggests that environmental factors are important among this age group. In particular, time spent outdoors and access to programmes and facilities appear to be most relevant, although this may reflect the fact that these factors have been most frequently studied.

Chapter 7

The broader context of the research

7.1 Introduction

This chapter provides background information on the broader context within which the current research took place. It gives an overview of current policy in Scotland which is relevant to the promotion of physical activity. Of most relevance is the national physical activity strategy, *Let's Make Scotland more Active* (Scottish Executive, 2003). However, there are other policy initiatives which reinforce the importance of working at different levels and with a range of partners in order to maximise opportunities for physical activity with schools, homes and communities. In relation to children and young people, schools have been identified as an important setting for the promotion of physical activity. The opportunities to promote physical activity across the school day are discussed and evidence for the effectiveness of school-based initiatives is presented. Finally, the chapter provides a description of the Physical Activity in Scottish Schoolchildren (PASS) study. Data from this study are presented in subsequent chapters in this thesis.

7.2 The policy context in Scotland

In recent years, physical activity has become a key focus of national and international policy documents. For example, the World Health Organization Global Strategy on Diet, Physical Activity and Health (WHO, 2004) was developed in response to recognition of the increasing health and economic burden of non-communicable diseases in developed and developing countries, and the role of unhealthy diets and physical inactivity as leading causes of the major non-communicable diseases.

In response to the rapidly increasing evidence base documenting links between physical inactivity and morbidity / mortality (as reviewed in Chapter 1), Scotland was one of the first countries in Europe to develop a national physical activity strategy. The strategy, *Let's Make Scotland more Active* was published in 2003. Its overall goal is to increase and maintain the proportion of physically active people in Scotland. In relation to children and young people, the strategy includes the target that, by 2022, 80% of children will meet the current recommended levels of physical activity (at least one hour of moderate intensity physical activity on each day of the week) (Scottish Executive, 2003). The strategy identifies Active Schools as one of four key settings for promoting physical activity.

More recently, a joint action plan on diet, physical activity and obesity was published. *Healthy Eating, Active Living: An action plan to improve diet, increase physical activity and tackle obesity* (Scottish Government, 2008) sets out a three year plan to address the problem of obesity in Scotland by promoting healthy eating and physical activity. In relation to physical activity, three broad objectives are identified:

- To create, improve and maintain the supply of natural and built environments encouraging more active lifestyles
- To develop, increase and maintain capacity in a wide range of settings and sectors to support people to become more active
- To stimulate interest in and demand for increased participation in physical activity by raising awareness in the general population and relevant professional groups about the health and wellbeing benefits and the recommended guidelines for achieving these.

In order to achieve these objectives, £12 million has been allocated to promoting physical activity within the Scottish population.

Current education policy also highlights the importance of promoting physical activity within the school setting. The curricular framework, *A Curriculum for Excellence* (Scottish Executive, 2004a), has at its core the aspiration that all young people will be successful learners, confident individuals, responsible citizens and effective contributors. New curricular guidelines are currently under development and physical education is now included as part of 'Health and Wellbeing'. Draft health and wellbeing experiences and outcomes, published in May 2008, highlight the important role of physical education, physical activity and sport in developing skills and promoting positive attitudes towards active living, and establishing patterns of daily activity which may be sustained into adulthood. As part of Curriculum for Excellence, schools are expected to continue to work towards the provision of two hours of good quality physical education for each child every week.

Recently, guidance has also been issued to schools in support of the Schools (Health Promotion and Nutrition) (Scotland) Act 2007. This Act places a duty on local authorities to endeavour to ensure that all schools are health promoting. Within each education authority, health promoting school strategies must form part of the annual statement of improvement objectives and subsequently form the basis of school development plans. The Act builds on earlier work undertaken by the Scottish Health Promoting Schools Unit (SHPSU, 2002-2007) which was set up in response to the target that all schools in Scotland become health promoting schools by 2007. Health promoting schools are those which adopt a whole-school approach to integrating health promotion into every aspect of school life. In collaboration with national and local partners, SHPSU produced *Being Well – Doing Well* (SHPSU, 2004), a framework for health promoting schools in Scotland. This document identified six key characteristics of health promoting schools, reflecting the different elements of school life which may impact on young people's health and wellbeing:

- Leadership and management
- Ethos
- Partnership working
- Curriculum, learning and teaching
- Personal and social development and health education programmes
- Environment, resources and facilities.

7.3 Physical activity and schools

Schools have been identified as a key setting for the promotion of physical activity among children and young people (Cale, 2000). The vast majority of children will attend school and provide a captive audience for physical activity programmes. In particular, school physical education (PE) is recognised as having a key role to play in promoting lifelong physical activity (McKenzie, 2001) and, increasingly, is seen as an important vehicle for achieving health-related physical activity outcomes. Over 15 years ago, van Wersch and colleagues stated that "*a physical education which does not prepare children for a life-long positive attitude towards exercise and sport stands in the way of goals which have to do with health and a meaningful use of leisure time*" (van Wersch *et al.,* 1992, p.58). More recently, Corbin has argued that the most important objective of PE should be "*to promote lifetime physical activity behaviours among all our students. We should continue to teach for learning in a wide variety of areas, but.... a focus on physical activity promotion should be paramount*" (Corbin, 2002, p. 139).

Research suggests that school-based PE programmes can be effective in increasing time spent in physical activity and improving fitness levels (Morrow *et al.,* 1999), although there is less evidence that these effects are maintained outside the school setting (Cale & Harris, 2006; Kahn *et al.*, 2002). In the UK, Fairclough & Stratton (2005) investigated the extent to which PE can contribute towards young people's overall physical activity. Using heart rate telemeters, they assessed physical activity levels during PE lessons in five secondary schools in the northwest of England. Students engaged in MVPA for, on average, 18 minutes per lesson. This equates to approximately one third of the daily recommended amount of physical activity, thus suggesting that PE can make a significant contribution to young people's physical activity levels. Levels of MVPA were found to be highest during team games (e.g. football, hockey) and lowest during movement activities (e.g. dance, gymnastics). Only around four minutes per lesson was spent in vigorous physical activity, suggesting that PE is unlikely to contribute to improvements in cardiovascular fitness.

Pate *et al.* (2006) suggest that further research is needed to clarify the relationship between in-school and out of school activity. It is possible that pupils who increase their levels of physical activity during the school day compensate by decreasing participation during their leisure time. Indeed, a study by Mallam *et al.* (2003) compared the amount of physical activity undertaken by primary-aged children from three schools with differing sports facilities and opportunities for curricular PE. They found that total time spent in physical activity was not affected by timetabled PE, suggesting a possible compensatory effect whereby those who do more physical activity in school are less active outside school. However, a more recent review of the effects of school physical education programmes on physical activity behaviour indicates that quality PE programmes of sufficient quantity can make a significant contribution to overall MVPA among school-aged children (Trudeau & Shephard, 2005).

In Scotland, following the report of the PE Review Group (Scottish Executive, 2004b), schools are expected to work towards the provision of two hours of quality PE for each child every week. However, recent figures suggest that only 5% of primary schools and 7% of secondary schools are achieving this goal (Scottish Executive Education Department, 2006). In addition to the time available for PE, the content of the curriculum offered is critical for promoting a physically active lifestyle in young people (Armstrong & Welsman, 1997). Studies indicate that there is a strong emphasis on sports and competitive team games, both within the school curriculum and through extra-curricular activities (Cale, 2000). Often these types of activities do not match the preferences of young people themselves. Welsman and Armstrong (2000) suggest that this discrepancy may be a significant barrier to schools fulfilling their obligation to promote healthy patterns of behaviour in young people and has implications for attempts to establish active lifestyles which may be continued into adulthood. There is evidence that team games are less likely to be continued into adulthood than ‘lifetime activities’ which typically require fewer people, less equipment and little structure or organisation (Fairclough *et al.*, 2002). For example, Sallis *et al.* (1989) found that children who were most active in team sports were more likely to watch sport on television as adults rather than participate themselves.

As noted by Fox & Harris (2003), curricular PE represents a very small proportion of a child's waking hours and therefore cannot be expected to provide the solution alone. Indeed, many aspects of school can influence physical activity behaviour:

"*Many aspects of the school can either promote or inhibit physical activity and, depending on what happens within and through the hidden curriculum, understanding can either be reinforced and supported or completely undermined.*" (Cale, 1997, p.72)

In addition to curricular PE, a range of opportunities are pertinent, including travel to and from school, activity during morning and lunch breaks, and extra-curricular sports and activities. Furthermore, the physical and social environment of the school can also influence physical activity behaviour. The physical environment includes space, facilities and other physical features of the school environment. The social environment includes policies, relationships, social support, role modelling and social norms. Sallis *et al.* (2001) investigated the association of school environments (space, facilities, equipment and supervision) with physical activity among US middle school students. Environmental characteristics explained 42% of the variance in physical activity among girls and 59% among boys. High levels of physical improvements (e.g. basketball hoops, tennis courts) and adult supervision were found to be particularly important. Experimental evidence also supports the importance of the school environment in facilitating physical activity (Sallis *et al.*, 2003). There is also evidence to suggest that school teachers have the potential to exert a negative as well as a positive influence on physical activity behaviour (Trudeau & Shephard, 2005). Furthermore, qualitative research has highlighted the importance of the learning environment and policies on issues such as clothing and showering in relation to pupils' attitudes towards PE and sport at school (Williams *et al.*, 2000).

Walking to school has been associated with higher levels of overall physical activity among both primary (Cooper *et al.*, 2003; Cooper *et al.*, 2005) and secondary (Alexander *et al.*, 2005) schoolchildren. In addition, cycling to school has been found to be associated with higher levels of cardiovascular fitness compared with walking or travel by car (Cooper *et al.*, 2006). Secular trends in the UK reveal decreases in the proportion of pupils walking to school in recent years (Department for Transport, 2003) and therefore efforts to promote active school travel are required. Recently, McKee *et al.* (2007) reported that a curricular-based active travel intervention resulted in a significant increase in walking to school with a corresponding decrease in travel by car. It is likely that children's active travel choices are constrained by a number of external factors, in particular, traffic congestion, poor infrastructure and parental safety concerns (Jago & Baranowski, 2004). Thus, interventions to promote active travel may need to address influences at a broader socio-environmental level in order to be effective.

A study in the UK found that children spent only 15% of their school break times in moderate-to-vigorous physical activity (Stratton, 1995). In a review of non-curricular physical activity interventions, Jago & Baranowski (2004) found that simple, low-cost interventions, such as painting playgrounds, implementing playground games and providing equipment, increased physical activity during break times by 17-60%. It should be noted, however, that these interventions were implemented within primary schools. It is likely to be more challenging to promote playground activity among older children.

Finally, schools offer the potential for increasing physical activity participation through provision of extra-curricular activities. However, in their review, Jago & Baranowski (2004) found little evidence to support the effectiveness of after-school programmes for increasing physical activity. Low attendance was a major barrier, suggesting that these programmes failed to provide appropriate or engaging activities for the relevant target groups. Indeed, a recent report of young people's participation in physical activity in Scottish secondary schools (Scottish Consumer Council, 2007) found that the majority of pupils do not take part in school-based extra-curricular sports and exercise. As with PE, research suggests that the nature of extra-curricular activities in schools, in particular, an over-emphasis on competitive games, may exclude some pupils from participation. Furthermore, according to Cale (1997, p.83), "the dominance of competitive team games over exercise activities may be denying many pupils the opportunity to participate recreationally in....the sorts of activities they may be likely to pursue in later life." Consideration also needs to be given to the context in which extra-curricular activities are delivered. Extra-curricular programmes appear to have had more success when these are incorporated as part of larger, multi-component interventions which target physical activity behaviour across a number of different settings (Cale & Harris, 2006). For example, recent findings from the Trial of Activity for Adolescent Girls (TAAG) study found that after-school programmes which were implemented in partnership with community organisations resulted in a small but significant increase in time spent in moderate-to-vigorous physical activity (Webber *et al.*, 2008). Similarly, van Sluijs *et al.* (2007) found that school-based interventions which included community or family involvement were effective in increasing physical activity among adolescents.

7.4 The Physical Activity in Scottish Schoolchildren (PASS) study

Within this policy and evidence context, the Physical Activity in Scottish Schoolchildren (PASS) study was developed in order to investigate physical activity behaviour among school-aged children in Scotland. Commencing in 2002, the PASS study was a five year prospective cohort study tracking young people from the final year of primary school (P7) to the fourth year of secondary school (S4). The key aims of PASS were as follows:

- To explore levels of physical activity among a sample of school-aged children in Scotland
- To track changes in levels of physical activity during the transition from primary to secondary school
- To investigate developmental, psychological, social and environmental predictors of physical activity
- To make recommendations to schools for the promotion of physical activity among this age group.

The research had three main components: an annual questionnaire survey of pupils, in-depth interviews with a sub-sample of pupils from one of the participating local authorities, and a school-level survey sent to Head Teachers in participating primary schools and Principal Teachers of Physical Education in participating secondary schools. The research presented in this thesis draws on data from the pupil survey and focuses specifically on the transition period as children move from primary to secondary school (P7 to S2) as this is the stage at which sharp declines in physical activity participation tend to occur, particularly among girls. For many young people, this period also coincides with the onset of puberty and thus represents a time of major change at the individual (biological and psychological) and supra-individual (social and environmental) levels. Due to time and word limitations of the thesis, results from the other study components are not reported here. However, findings from the qualitative research in particular have informed the understanding and interpretation of the questionnaire data.

7.5 Summary

Current health and education policy in Scotland emphasises the need to promote physical activity among the Scottish population and young people, particularly adolescent girls, are frequently identified as a priority group. In recent years, increased resources have been allocated to support physical activity promotion across a number of sectors, including health, education, transport and the environment. In relation to children and young people, schools are recognised as an important setting for encouraging the development and maintenance of active lifestyles which may be continued into adulthood. In particular, physical education provides a key channel through which to enhance young people's skills and foster positive attitudes towards physical activity. There is emerging evidence that PE can make a significant contribution towards current recommended levels of physical activity among young people. However, additional opportunities to be active exist throughout the school day and must also be promoted within a whole school approach to physical activity. Furthermore, there is recognition that physical activity behaviour is facilitated by supportive physical and social school environments. In light of this, PASS study was developed in order to explore physical activity behaviour among early adolescents in Scotland. The study is described in more detail in Section 2 and findings are presented in Section 3.

Section 2

METHODS

Chapter 8

Research aims and objectives

"The fact that there appear to be multiple correlates of physical activity behaviour across a number of categories of variables (intrapersonal, interpersonal, socio-cultural, physical environmental) suggests a complex causal web and indicates the need for a multilevel ecologic approach to understanding physical activity."
(Bauman *et al.*, 2002, p.10)

8.1 Introduction

In the previous section, an overview of relevant evidence was provided as a rationale for investigating physical activity behaviour among the early adolescent population. In addition, key correlates of physical activity behaviour among children and adolescents were identified to guide the selection of variables for inclusion in the current study. Methodological aspects of the study are now discussed. The primary aim of this thesis is to investigate the determinants of leisure-time physical activity within the early adolescent age group in Scotland. The research presented in this thesis uses data collected as part of the Physical Activity in Scottish Schoolchildren (PASS) project, a 5-year longitudinal study of physical activity behaviour and determinants among school-aged children in Scotland. Specifically, two years of data from the study, spanning the period of transition from primary to secondary school, are analysed. This chapter provides a context for the study and presents the key research questions which will be addressed.

8.2 Investigating the determinants of physical activity behaviour among adolescents

Adolescence has been identified as a critical period for physical activity promotion (Rowland, 1999). As discussed previously, it is believed that behavioural habits – and associated health risk factors - established in adolescence track into adulthood.

As the biological drive for physical activity wanes, socio-environmental factors are thought to become more relevant. Increasing autonomy and independence during the teenage years gives young people greater control over the choices they make, particularly in relation to how they spend their leisure time. The influence of parents declines, and peer groups become an increasingly important context for the development of health-related attitudes and behaviours.

In order for opportunities for promoting physical activity to be maximised and to ensure that policies and programmes are appropriate and effective, there is a need to identify the determinants of physical activity among the early adolescent population. Sallis and Owen (1999) have outlined a framework for investigating the link between health behaviours and health-related outcomes and understanding the determinants of behaviour. Applying this framework to physical activity behaviour, Biddle *et al.* (2004), highlight five phases:

1. To establish the link between physical activity and health
2. To develop methods for the accurate assessment of physical activity
3. To identify factors that are associated with different levels of physical activity
4. To evaluate interventions designed to promote physical activity
5. To translate findings from research into practice.

The links between physical activity and health are now well-documented and have been discussed in Chapter 1. Methodological considerations in the assessment of physical activity were discussed in Chapter 2 and a number of established, validated measures now exist. Thus, the specific aims of this research relate to Phase 3 of the above framework in terms of examining relationships between modifiable influencing factors and physical activity among adolescents in Scotland. Following on from this, the findings will be used to inform development and evaluation of interventions aimed at promoting physical activity among the school-age population in order to provide a robust evidence base for future policy and practice.

The research presented in this thesis is based on analyses of data from two waves of data collection in the PASS study. Wave 1 represents data collected during the final year of primary school (P7) and Wave 2 represents data collected during the second year of secondary school (S2). These time points were chosen in order to investigate specific changes occurring during the transition from primary to secondary school. The specific research questions arose from an interest in understanding why levels of participation in physical activity typically decline during the early adolescent years. S2 was chosen as the second time point as it was close to the period of transition, but allowed time for any initial fluctuations in behaviour in the months immediately following the move to secondary school to have stabilised into more established patterns of behaviour.

Based on evidence from the literature review presented in earlier chapters, a wide range of potential correlates of physical activity have been identified. These can be broadly classified as biological, psychological, social and environmental. The research presented in this thesis focuses primarily on the latter three categories. Due to the problems associated with collecting data on biological determinants using self-report methods, these are not addressed here. Little research has previously been undertaken to investigate those factors which are associated with physical activity behaviour among young people in Scotland and no other longitudinal studies focusing on the same research questions are known to exist.

The research is not designed to test one particular behavioural model or theory. As discussed previously in Chapter 3, existing theories of physical activity behaviour have their own strengths and weaknesses and, while all provide valuable contributions to our understanding, no one theory can adequately explain the complexity of physical activity behaviour. Perhaps a failing of previous work in this area has been to focus on more narrow theoretical approaches, linked to specific disciplinary perspectives. Much is to be learnt from these independent disciplines and all have contributed greatly to the existing evidence base. However, there is a need to integrate different theoretical frameworks and disciplinary perspectives in order to gain a fuller understanding of young people's physical activity behaviour. The application of socio-ecological models to the study of health behaviours has begun to facilitate this process, but an integrative approach is still relatively new within the field of physical activity and particularly among children and adolescents.

If physical activity interventions among the adolescent population are to be effective, they must be informed by empirical research which explores the range of potential influences on physical activity and the way they may interact to determine behaviour. Accordingly, in investigating the determinants of physical activity behaviour among early adolescents, this research draws on psychological, sociological and environmental perspectives and seeks to integrate these within a public health framework.

8.3 Research questions

The overarching research question addressed in this thesis is: ***What are the key determinants of physical activity among early adolescents in Scotland?*** The study is primarily concerned with the description, explanation and prediction of physical activity behaviour. Specific research questions which will be addressed are as follows:

- How does physical activity behaviour change across the primary-secondary school transition?
- What are the main psychological influences on physical activity?
- In what ways do family and peers influence physical activity?
- Are physical environmental characteristics of the area in which young people live associated with physical activity?
- Is pubertal development associated with physical activity?
- Do predictors of physical activity vary by age and gender?
- What is the relative influence of psychological, social and environmental factors on physical activity behaviour?

These questions will be addressed through the development and testing of theoretical models with the aim of identifying the key predictors of physical activity among Scottish 11-13 year olds. In the first phase of analysis, three separate models will be developed to investigate the role of (1) psychological, (2) social and (3) environmental factors on physical activity. These models will be tested individually to explore the relationships between key explanatory variables and physical activity behaviour. Having identified the correlates of physical activity through analysis of cross-sectional data, an integrative model will be developed. Finally, longitudinal models will be examined in order to identify P7 predictors of physical activity in S2.

Chapter 9

Research Design

9.1 Introduction

The data presented in this thesis were collected as part of the Physical Activity in Scottish Schoolchildren (PASS) study. One of the specific aims of the PASS project was to inform the development of future physical activity interventions so that the opportunities provided for young people to be active are evidence-based and more relevant, appropriate and accessible. In order for this to happen, the factors which influence whether or not a young person takes part in physical activity need to be more fully understood. These factors are known as determinants or predictors of behaviour. The ability of research to enhance our understanding of behavioural determinants depends on the methodological approach employed. Important methodological considerations include study design, sampling, recruitment, ethics, questionnaire development, piloting and survey administration. This chapter provides a discussion of these issues with specific reference to how they were addressed within the current research.

9.2 Choosing an appropriate study design

Identifying and utilising an appropriate study design are essential to answering the research question. Choice of study design is therefore determined by the research question itself and informed by epistemological and ontological perspectives. The research presented in this thesis draws primarily on a positivist paradigm. Positivism is based on a 'realist' ontology, that is, it assumes that social reality exists independently of the observer (researcher). Observations of social phenomena are represented as 'concepts' and the relationships between concepts can be observed, described and generalised. Within a positivist paradigm, "*scientific knowledge consists of well-established regularities that are arrived at by the accumulation of data.*" (Blaikie, 2000, p.103). This approach is typically favoured by policy makers but, within the social science arena, may be limited in its interpretation especially in relation to individual differences, quality of experience or meaning of change. While analysis of population effects using aggregate level data is useful for informing policy and practice, it is important to bear in mind that this type of data will fail to capture the unique experiences of individuals.

Within a positivist framework, two distinct research strategies - 'inductive' or 'deductive' - may be employed. While sharing similar ontological assumptions these two strategies have different epistemological perspectives, i.e. they differ in the assumptions about *how* social reality can be described or explained. In the inductive research strategy, the aim is to establish theory based on new observations of reality. It assumes that universal generalisations can be developed through the accumulation of data and used to explain social (behavioural) patterns. In the deductive research strategy, the aim is to test existing theories and eliminate false ones through rigorous and critical evaluation.

Despite these differences, the research presented in this thesis draws to some extent on both strategies. It is primarily inductive in nature, seeking to explore relationships between variables which may influence physical activity patterns and, subsequently, to develop and test models which may provide some generalisable explanations of behaviour. However, while not attempting to test any one specific theory, the research is strongly informed by existing models and theories from the health behaviour field. Selection of constructs for inclusion in the study was guided by empirical evidence as well as by established theoretical explanations of the way in which health behaviours are constructed, patterned and operationalised in children and adolescents.

Of particular interest is the decrease in physical activity participation which is typically observed during early adolescence. As discussed in Chapter 2, this pattern has been consistently identified in different studies, across different countries and using different methods of measurement. Data from both the Scottish Health Survey (Stamatakis, 2005) and the Health Behaviour in School-aged Children study (Currie *et al.*, 2004) clearly show this age-related decline in activity levels among adolescents in Scotland, particularly among girls. The data suggest that there is something significant taking place at this stage of life which affects young people's physical activity behaviour. Many studies have been undertaken to identify correlates of physical activity in children and adolescents and a number of factors have been found to be significantly associated with physical activity behaviour (see Chapters 4 to 6). However, understanding of these relationships is limited by the cross-sectional nature of most of these studies, a lack of integration of disciplinary perspectives and the failure of any one theory to adequately explain physical activity behaviour among this age group.

9.3 Longitudinal research

From an intervention perspective, there is a need to identify *determinants* or *predictors* of behaviour for which a longitudinal design is required. Longitudinal research provides an opportunity to explore the issue of causality by measuring the outcome variable on the same individual at several different time points, thus establishing temporal order. While the notion of cause and effect is central to epidemiological research, prospective observational studies can only partly answer the question of causality (Twisk, 2003). Causality may be inferred but cannot be proven. Instead, Twisk argues that "the main advantage of a longitudinal study compared to a cross-sectional study is that the *individual development* of a certain outcome variable over time can be studied. In addition to this, the individual development of a certain outcome variable can be related to the individual development of other variables" (Twisk, 2003, p.2).

Longitudinal research is defined in terms of the data, subjects and methods of analyses. Put simply, it is the observation of subjects on a number of variables over time (van der Kamp & Bijleveld, 1998). According to Menard (2002), there are three distinctive features which characterise longitudinal studies:

1. Data are collected for each item or variable for two or more distinct time periods.
2. The subjects or cases are the same or at least comparable from one period to the next.
3. The analysis involves some comparison of data between or among periods.

Types of longitudinal design include prospective cohort, retrospective cohort and repeated cross-sectional studies.

Longitudinal research is typically less common in social research because of the costs and organisational challenges associated with it. However, there are a number of important advantages over cross-sectional research. The utilisation of a prospective observational cohort design for the current research allows for analysis of *change* in physical activity behaviour. Changes in behaviour are assessed across the primary-secondary school transition, which is of particular interest as this transitional period typically corresponds with an observed decline in physical activity, especially among girls. Inter-individual and intra-individual changes over this two-year time period can then be described both in terms of magnitude and patterning. Furthermore, investigation of the *temporal order* of events can provide greater insight into causal relationships between variables than cross-sectional research allows.

9.4 Research methods

Data were collected by self-report questionnaire survey. Surveys are characterised by the collection of a structured dataset and are commonly employed in behavioural and epidemiological research. They are particularly useful for gathering systematic information from large samples and, in longitudinal research, for examining changes within and between groups over time.

The limitations of self-report measures of physical activity have been discussed previously in Chapter 2. Despite these, LaPorte *et al.* (1985) have argued that recall survey instruments currently offer the best compromise as epidemiologic measures of physical activity in large populations. Although written over 20 years ago, the same could be said today. There have been ongoing methodological developments during this time and objective measures such as accelerometers are now more widely available. However, such tools remain expensive and demand a much higher level of participant engagement making them inappropriate for use with large samples. In seeking an appropriate method for physical activity assessment, there is therefore a need to balance the desire for accuracy against the need to ensure representativeness of both the behaviour and the population being studied (LaPorte *et al.*, 1985). It should also be noted that the primary focus in the current study is to investigate relationships between variables. Thus, establishing accurate estimates of prevalence is less important. Indeed, while the data collected may provide useful measures of subgroup differences and changes over time, it cannot be assumed to represent absolute levels of physical activity. Furthermore, when using self-report instruments, the data collected represents subjective perceptions of reality and it is therefore feasible that these may be represented differently if gathered under different circumstances or using alternative research methods.

9.5 Sampling framework

Sampling

Selection of the study sample was based on a multistage cluster sampling approach, with the units of sampling being (a) local authority area and (b) school clusters. The study was undertaken as part of a broader programme of research and evaluation funded, at the time, by NHS Health Scotland as part of the European Network of Health Promoting Schools (ENHPS) in Scotland. Decisions about which local authorities and schools to include in the study were therefore made in collaboration with the funding agency. In the first instance, purposive sampling was used to identify local authorities which would be invited to participate in the study. Three key criteria were used: it was decided to approach local authorities (a) which had not taken part in the previous phase of ENHPS research, (b) where the research team or funding agency had existing contacts within the Education Department and (c) which represented a mix of urban and rural areas. Based on these criteria, four local authorities were selected for inclusion in the study: Angus, Fife and Glasgow City and West Lothian.

Power considerations

Power represents the probability of a study of a given sample size correctly identifying a true difference or effect in the populations studied. The larger the sample size, the smaller the standard error. Smaller standard errors mean that parameter estimates are more accurate. If the sample size for a study is too small, it may not be possible to detect associations that actually exist, leading to Type II error (i.e. wrongly accepting the null hypothesis).

For the current study, initial power calculations were based on observed age differences in moderate-to-vigorous physical activity in the Health Behaviour of School-aged Children (HBSC) study. Unpublished data from the 2002 survey showed around a 10% decrease in the proportion of pupils meeting the current MVPA guideline between Primary 7 and Secondary 2. In order to have 80% power to detect a similar change of 10% over two years, at a significance level of 95%, a sample size of 380 was required.

Similarly, for the F test in multiple regression analysis with 80% power at a significance level of 95% and an effect size of 0.05, the required sample size was 335, based on having ten independent variables within the model.

Recruitment of schools

Following selection of four local authority areas for inclusion in the study, a key contact within each education department was identified and information about the study was sent to them. All four local authorities expressed interest in taking part and approval for the study to proceed was given by the Director of Education. A meeting was then arranged with the key contact for each area and a representative from the corresponding NHS Health Promotion Department in order to discuss the selection of schools for participation. In order to ensure the required sample, two school clusters were selected from each local authority where each cluster included one secondary school and its associated primary schools. Each school cluster was required to be reasonably large (around 200 pupils per year group) and within a mixed catchment area in order to allow for a varied socioeconomic profile across the whole sample.

Once schools had been identified for participation, the initial approach was made by the Local Authority representative (typically an Education Officer with a remit for Physical Education or a Sports Development Manager) as they were already known to schools in the area. An information sheet providing details of the study was given to schools at this stage. Once schools had given verbal agreement, a follow-up letter was sent to the Head Teachers of secondary schools and associated primary schools requesting them to sign and return a Reply Form if they were willing to take part. With the exception of two denominational primary schools, all schools which were approached agreed to participate.

Sample profile

Figure 9.1 provides an overview of the final sample. Within each of the four participating local authorities, two secondary schools were included. Based on the Scottish Government urban rural classification index[c], two of the participating secondary schools are defined as 'large urban', five as 'other urban' and one as 'accessible town'. The number of primary schools within each cluster ranged from four to nine. The number of pupils in Primary 7 within each cluster ranged from 162 to 272 at baseline. The proportion of pupils entitled to free school meals within each secondary school ranged from 4.4% to 47.5%.

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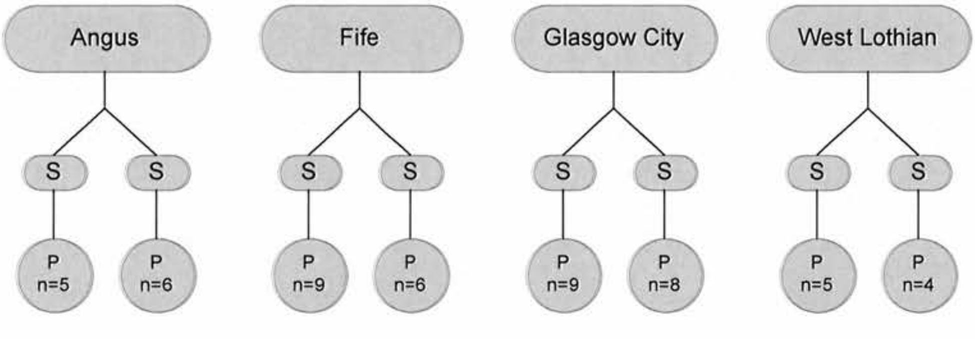
[c] Large Urban Areas = Settlements of >125k people; Other Urban Areas = Settlements of 10-125k people; Accessible Small Towns = Settlements of 3-10k people and within 30 minutes' drive of a settlement of 10k or more; Remote Small Towns = Settlements of 3-10k people with a drive time of over 30 minutes to a settlement of 10k or more; Accessible Rural = Settlements of <3k and within 30 minutes' drive of a settlement of 10k or more; Remote Rural = Settlements of <3k and with a drive time of over 30 minutes to a settlement of 10k or more.

Figure 9.1: Profile of PASS sample



P = primary school, S = secondary school

9.6 Questionnaire development

Variables for inclusion in the study were identified from the existing literature based on their reported influence on physical activity participation within the early adolescent age group. Once variables had been identified, advice was sought from colleagues and further literature searches were undertaken to identify existing instruments or items which could be used.

In addition, key author searches were undertaken and websites of experts in the field were also searched in order to identify any further measures which might be available online. Two websites, the homepages of Dr Jim Sallis at San Diego State University[d] and Professor Nola Pender at the University of Michigan[e], proved particularly useful sources of information. Both these sites provided links to physical activity instruments which could be downloaded.

Several research instruments were detailed within published papers but, where this was not the case, personal requests for copies of relevant questionnaires were made directly to corresponding authors by letter or email. The Self-Description

[d] www.drjamessallis.sdsu.edu
[e] www.nursing.umich.edu/faculty/penderinstruments/researchinstruments.html

Questionnaire 1 was purchased from the University of Western Sydney, Australia specifically for the study. Once a draft questionnaire had been prepared, it was sent out to established academics with specific expertise in physical activity and health for comment (Professor Stuart Biddle, Professor Nanette Mutrie and Professor Yngvar Ommundsen) and reviewed internally by colleagues in the Department for Physical Education, Sport and Leisure Studies (Professor Fred Coalter and Mr Mike Jess). Details of all measures used in the current study are given in Chapters 10 (dependent variable) and 11 (independent variables) and a copy of the final questionnaire is shown in Appendix 1.

9.7 Piloting

Prior to the first wave of data collection, the questionnaire was piloted in two primary schools within the City of Edinburgh which were not participating in the main study. The questionnaire was administered to one primary 7 class during class time within each school. The piloting process aimed to assess a number of issues, including time taken to complete the questionnaire, potential problems with the wording or response format of questions and items which may have been considered sensitive. Following completion of the questionnaire in the classroom, the researcher (JI) met with a small number of the pupils in order to receive feedback on the questionnaire and discuss any specific problems. Following this pilot study, a small number of changes were made to the questionnaire. In particular, response formats were standardised where possible to promote consistency.

9.8 Ethical considerations

Ethical approval for the PASS study was granted by the School of Education Research Ethics Committee at Edinburgh University. Ethics is a complex area but is primarily about "*helping the researcher to be more aware of hidden problems and questions in research, and ways of dealing with these*" (Anderson, 2004, p.99). Research ethics provide a safeguard for both researcher and research participants. Key ethical considerations in research are essentially based on a number of principles including respect, protection and participation. *Respect* includes being honest, fair and not subjecting research participants to unnecessary burden. In research with children and young people, respect is particularly important so as to avoid being patronising or insensitive, and to recognise the need to understand the world as perceived by the young people themselves rather than filtered through an adult or 'professional' perspective.

Research with children and young people aims to enhance our understanding of the issues that are relevant to them so that their lives may be improved in some way. Thus, the research process should also ensure that participants are *protected* from harm, both during and after data collection. Social research is unlikely to cause direct harm to children, but it may have the potential to cause anxiety, embarrassment, social isolation or discrimination, depending on what is asked of the children and how the process of data collection is managed. It may also mislead children if the true purposes of the research are not revealed. Consideration should be given to the use and dissemination of research findings to ensure that these are not detrimental to those whose lives or views are represented.

Research must also be based on the principal of *participation* so that children are given the opportunity to express their views and to feel that their views will be taken seriously. Fundamental to participation is the process of informed consent whereby children are willing participants who understand the purposes of the research and what the information they provide will be used for. Within health promotion research, there is an increasing move towards using participatory methods with children to allow them to take an active role in all stages of the research process from planning through to dissemination. The use of questionnaire surveys, however, particularly in large-scale epidemiological or behavioural research, rarely allows for a high level of interaction or meaningful participation of children and young people. In such cases, one should take care to view those taking part as participants rather than subjects and aim to provide opportunities for the child or young person to express their views as fully as possible within the scope of a questionnaire (e.g. using open-ended responses where appropriate). It is also important to ensure that there is no degree of coercion from those overseeing survey administration, particularly within a school setting where established power relationships between staff and pupils, or between pupils, may affect young people's willingness to express their views freely.

Following these principles of ethical research, it was considered essential that children and young people taking part in the PASS study were willing participants in the research process. Pupils were asked to give active consent to take part, and an information sheet and consent form were designed specifically for this purpose (see Appendix 2). In the first year of data collection (P7), a researcher read through the information sheet with each class, and was available to answer any questions, before asking those who were willing to take part to sign the consent form. Only two children decided to withdraw from the study. Parental consent was also important due to the age of the pupils at the start of the study. Information sheets and consent forms (see Appendix 2) were initially issued to parents of all P7 pupils via the participating schools in advance of commencement of the research. An 'opt-out' system was employed whereby any parent wishing to withdraw their child from the study was able to do so by returning a signed form. Parental and pupil consent was also gained for all those joining the study in subsequent years.

Respect for children includes taking the issue of confidentiality seriously. Because PASS was a longitudinal study, it was necessary to be able to track individual pupils throughout the course of the research. Therefore, questionnaires were not anonymous but steps were taken in order to ensure confidentiality. Each pupil was allocated an individual ID number which was used at all times so that pupils did not need to write their names on the questionnaires. In order to manage this process, schools were required to issue lists of pupil names at the start of each year. Pupil names were stored electronically for access only by the research team and original copies of class lists were stored securely in a locked cabinet until the end of the study.

9.9 Survey administration

In all schools, the questionnaire was administered to pupils during class time. In Wave 1 (P7), a researcher went in to each school and administered the questionnaire to pupils with the class teacher present. A team of experienced researchers was recruited specifically for this purpose and given a full briefing in advance of data collection to ensure consistency of approach. Schools were asked in advance if additional support would be required for specific pupils. Where this was requested, two or more researchers went to the school to provide extra support during survey administration, for example, one-to-one assistance for children with additional support needs.

For subsequent waves of data collection, schools were asked to identify a class period during which the survey could take place and the questionnaire was administered by the class teacher. In most cases, this was a physical education class but in some cases it was carried out during other subject periods such as personal and social education. Guidelines for class teachers were provided in order to standardise the process of administration (see Appendix 2). Teachers were asked, where possible, to separate desks and ensure there was no discussion between pupils during completion of the questionnaire. In order to ensure confidentiality, all questionnaires were issued with an empty envelope. When pupils had finished completing their questionnaire, they were able to put it into the envelope and seal it. This meant that completed questionnaires could not be read by any members of staff at school before being returned to the research team.

Teachers were also given a Class Response Form (see Appendix 2) to complete while the survey was being carried out. This provided a record of the number of pupils usually in the class, the number completing a questionnaire and reasons for absence. This form had previously been developed for use in the HBSC survey in Scotland. Teachers were asked to return the forms with the completed and uncompleted questionnaires from each class and these were then used to track the extent of, and reasons for, non-response.

Chapter 10

Definition and measurement of physical activity

10.1 Introduction

This chapter presents a discussion of the key issues for consideration in selecting the physical activity outcome measure for the study. A number of different items were included in the PASS questionnaire to measure levels of physical activity participation. These included items intended to assess different *types* of physical activity (for example, participation in specific sports or membership of sports clubs), different *intensities* of physical activity (including moderate and vigorous), and physical activity in different *contexts*, particularly school-based activity and leisure-time activity. The latter category distinguishes the volitional choices the children make about physical activity in their free time compared with non-volitional activity which takes place primarily during school hours such as in physical education classes. It is important to distinguish between different categories of physical activity because determinants may vary according to type, intensity or context.

Of the physical activity items included, three existing items/scales were identified at the outset as possible outcome measures for use in the analyses. These are presented below with discussion of their perceived advantages and disadvantages, followed by a rationale for the selection of the Physical Activity Questionnaire for Older Children (PAQ-C) as the dependent variable in the current study. It is important to reflect on some of the broader methodological issues to be considered when selecting an appropriate outcome measure; these are discussed first.

10.2 Measurement issues

Due to its multidimensional nature, the measurement of physical activity is particularly complex. A wide range of self-report measures have been developed but there is little standardisation of definition or measurement technique. A number of important issues need to be considered when selecting an appropriate outcome measure. These include: measurement error, sensitivity to change, reliability, validity, acceptability to the respondent, and cost of administration. The latter two criteria have been addressed in Chapter 2. Measurement error, sensitivity to change, reliability and validity will be discussed here.

Measurement error

Error is associated with all self-report measures of physical activity. Error may arise from problems associated with the properties of the instrument itself or from response bias. Response bias occurs when missing values in a dataset are non-random with respect to the outcome of interest. It may also result from bias in reporting, for example, when individuals seek to give the 'right' or socially acceptable response. Another important source of error is associated with cognitive processing and the ability of human beings to accurately recall their behaviour. This is commonly referred to as recall bias. Recall of physical activity is especially problematic. For example, there is evidence to suggest that individuals may over-report time spent in physical activity, particularly in relation to sports and vigorous intensity activities (Graff-Iverson *et al.*, 2007). Similarly, it is likely that light to moderate physical activities may be under-reported as these are often less structured and spontaneous, and may therefore have fewer contextual cues to aid memory retrieval (Gard & Wright, 2005).

Sensitivity to change

Sensitivity to change relates to the degree of change that can be measured by a specific item or instrument. Change may occur naturally over time or may result from an intervention. Sensitivity to change is particularly important in relation to discriminating between individuals and groups, monitoring trends over time and avoiding false-negative results from interventions. Measures should be of sufficient detail to capture differences between individuals where these exist.

In relation to the properties of a questionnaire item or instrument, lack of sensitivity to change may occur for a number of reasons (Fitzpatrick *et al.*, 1992), including:

- Larger, more generic instruments may include a number of items of low relevance to the population or outcome of interest
- Instruments may include items which assess dimensions which are relatively stable or not a feasible target of the intervention
- Measures may be subject to ceiling or floor effects
- Measures contain too few broad categories to be sensitive enough to subtle changes within the target population.

Reliability

Reliability relates to the consistency or repeatability of an instrument. An instrument may be considered reliable in the extent to which it produces the same score or value on more than one occasion. Three types of reliability may be assessed. Test-retest reliability is the agreement between measurements taken at different time points using the same method. Inter-rater reliability is the agreement between different observers or raters. Finally, internal consistency is the extent to which items within a scale or instrument are consistent with one another i.e. measure the same general construct. Statistical measures of reliability are expressed in terms of a coefficient that can have values ranging from 0 (no consistency) to 1 (perfect consistency).

Previous research has found highest test-retest reliability for measures of vigorous or strenuous activity (Godin & Shephard, 1985; Folsom *et al.*, 1986), suggesting that these types of activities may be easiest to recall. This may be because vigorous exercise is more likely to occur during structured or organised sessions within a specific time period, or because it requires more strenuous effort which may be more memorable than low or moderate intensity activity.

Baranowski (1988) investigated the reliability of different types of physical activity self-report measures. He found that test-retest reliability was generally high when patterns of habitual or usual physical activity were measured using the same instrument applied to the same group of people. Lower, more moderate reliability coefficients were found when the measurements of physical activity related to a specific and non-overlapping time period such as the previous week. However, this may be a reflection of true variability in physical activity behaviour within the population and highlights the difficulty of establishing reliability of measures in children and young people whose activity patterns tend to be much less stable than those of adults.

Validity

Validity refers to the extent to which an instrument measures what it is intended to measure. It is dependent on reliability such that a valid measure is reliable but high reliability does not necessarily mean that the measure is valid (Mauthner & Platt, 1998). There are four types of validity which may be assessed:

- Face validity
- Content validity
- Criterion validity
- Construct validity

Face validity refers to the extent to which an instrument appears to measure what it is meant to measure. It is based on intuitive judgement rather than established theory. This is the most basic form of validation and should be considered insufficiently robust for making a judgement about overall validity.

Content validity relates to the extent to which a measure reflects all facets of a given construct. It is related to, but distinct from, face validity in that it requires the researcher to have some prior theoretical conceptualisation of the construct and a definition of the relevant domains. Each of these domains should then be represented within the measure.

Criterion validity relates to how well an instrument compares with an alternative method of measuring the same construct. It is also sometimes referred to as concurrent validity. The relationship between two methods is assessed statistically. The validity and accuracy of the alternative method or 'criterion' is key to establishing criterion validity. However, this is typically problematic in physical activity research because of the limitations associated with the different techniques which are available (Welk, 2002). There is no established 'gold standard' against which self-report measures can be compared. Studies typically validate self-report instruments by using some form of objective measurement such as motion sensors and/or heart rate monitors. The limitations of each of these have been discussed previously. For example, heart rate varies by level of cardiovascular fitness and may be affected by psychological symptoms (e.g. anxiety), environmental conditions (e.g. heat) and fatigue. Thus, these forms of measurement are likely to provide an over-estimate of time spent in physical activity.

Construct validity is determined by empirical evidence which supports what is known about the measure. For example, if a group which is known to be more physically active than another group scores more highly on the instrument, then this would provide support for construct validity. Similarly, construct validity is also demonstrated when two measures which are theoretically similar are highly correlated (convergent validity) or when two measures which are theoretically distinct are poorly correlated (discriminant validity).

10.3 Physical activity measures

Measure of moderate-to-vigorous intensity physical activity

Moderate-to-vigorous physical activity (MVPA) was assessed using a two-item measure developed as a screening tool for use with adolescents in the primary care setting (Prochaska *et al.*, 2001). However, it is also recommended for use in assessing participation in overall physical activity and for assessing achievement of current guidelines. It has subsequently been adopted for use in the Health Behaviour in School-aged Children (HBSC) study (Currie *et al.*, 2002). The two items assess the number of days that adolescents participate in moderate-to-vigorous intensity physical activity (MVPA) for at least 60 minutes, during (i) the past 7 days and (ii) a typical week.

The two items are shown below. The following definition of MVPA precedes the items: *Physical activity is any activity that increases your heart rate and makes you get out of breath some of the time. Physical activity can be done in sports, school activities, playing with friends or walking to school. Some examples of physical activity are running, walking quickly, cycling, dancing, skateboarding, swimming, football, and gymnastics.*

For these next two questions, add up all the time you spend in physical activity each day.

(i) **Over the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?**

(ii) **Over a typical or usual week, on how many days were you physically active for a total of at least 60 minutes per day?**

Responses: 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7 days

A mean of the two items is calculated to provide a composite measure of MVPA. A key advantage of the MVPA measure is that it allows respondents to be categorised according to whether or not they meet the current recommendation for daily participation in 60 minutes of moderate physical activity. Respondents with a score of seven or more are categorised as meeting the current guideline and respondents with a score of less than seven are categorised as not meeting the current guideline. Criterion validity and test-retest reliability of the measure were assessed among an adolescent population in the USA (Prochaska *et al.* 2001) and it was found to be reliable (intraclass correlation = 0.77) and valid when compared with accelerometer data ($r=0.40$, $p<0.001$).

Further validation work has since been undertaken in Finland, Norway and Scotland (as yet unpublished). Among 13 year olds in Scotland, comparison with accelerometer data suggested that the self-report measure significantly underestimates total physical activity. It does, however, reflect gender differences in participation. International data from the HBSC study also shows the expected age and gender differences (Currie *et al.*, 2004). Therefore, while there is some doubt as to its ability to accurately represent total physical activity levels, the measure may still be useful as an outcome measure when exploring patterning of behaviour across population sub-groups.

However, preliminary analysis of data from the MVPA measure used in the PASS study found no significant change in activity levels over the three survey years. This was unexpected given the well-established decreases in physical activity with age among adolescents, especially girls. This failure to be sensitive to changes in physical activity over time suggests a lack of construct validity. It therefore seemed inappropriate to use this as the outcome measure for the current study, especially if change in physical activity over time is to be included in the analyses.

Vigorous-intensity physical activity

Vigorous intensity physical activity (VPA) was measured using two items from the Health Behaviour in School-aged Children (HBSC) study (Currie *et al.*, 2002). These items have been included in the HBSC study since it began in the early 1980s (Aaro *et al.,* 1986). The items assess leisure-time participation in vigorous intensity physical activity in relation to (i) frequency and (ii) duration, as follows:

- **OUTSIDE SCHOOL HOURS: How OFTEN do you usually exercise in your free time so much that you get out of breath or sweat?**
  Every day
  4 to 6 times a week
  2 to 3 times a week
  Once a week
  Once a month
  Less than once a month
  Never
- **OUTSIDE SCHOOL HOURS: how many HOURS a week do you usually exercise in your free time so much that you get out of breath or sweat?**
  None
  About half an hour
  About 1 hour
  About 2 to 3 hours
  About 4 to 6 hours
  7 hours or more

Booth *et al.* (2001) assessed the validity and test-retest reliability of these vigorous physical activity items among a sample of 2026 13- and 15-year old high school students in Australia. Validity of the self-report items was assessed by comparing responses with aerobic fitness measured using the 20m Shuttle Run Test which itself has been shown to be a valid and reliable field test for use with children and adolescents (Freedson *et al.*, 2000). Booth *et al.* (2001) categorised pupils as "active" or "inadequately active" according to their combined responses to the two VPA items. Pupils who reported participating in vigorous activity for at least one hour a week and at least 2-3 times a week were categorised as active. Those pupils who did not reach this level of frequency and/or duration of vigorous physical activity were categorised as inadequately active. These categorisations were designed to fit with previous physical activity guidelines which specified that individuals should participate in vigorous intensity physical activity for at least 20 minutes and at least three times a week.

For both the individual items and the combined dichotomous measure, those categorised as 'active' had significantly higher fitness than the 'inadequately active' group for both boys and girls and at both ages. Booth and colleagues accept that this provides only a partial validation of the self-report items as fitness is not a direct measure of physical activity and can be affected by factors other than physical activity participation. No other validation studies of the VPA items have been identified. Test-retest reliability was assessed by administering the questionnaires on two occasions with a two-week interval among a sub-sample of 226 students. Percentage agreement ranged from 28% for the duration item among 13-year-old girls to 59% for the frequency item among 15-year-old girls. Kappa scores for the individual items ranged from 0.22 for the duration item among 13-year-old boys to 0.60 for the frequency item among 15-year-old boys, indicating poor to moderate reliability. For the combined measure percentage agreement values were higher (range 67% to 85%), but kappa scores were generally lower (range 0.12 to 0.38, with the exception of 15-year-old boys for whom kappa was 0.70). Booth *et al.* argue that, given the skewed distribution towards the active category for both 13- and 15-year olds, the percentage agreement provides a better indication of test-retest reliability and thus concluded that reliability of the items was acceptable within the study sample.

There are, however, two key disadvantages to using the VPA items as an outcome variable. Firstly, it is likely that children over-report participation in vigorous physical activity. For example, children may recall having played basketball for an hour, but the actual amount of physical activity which may be classified as vigorous during that hour is likely to be considerably less. Thus, measures of VPA may over-represent physical activity levels. Secondly, and more importantly, from a public health policy perspective, the emphasis has shifted during the last decade from vigorous to moderate physical activity. Thus, measures which focus solely on vigorous physical activity have less relevance to current policy and practice.

Physical Activity Questionnaire for Older Children

The Physical Activity Questionnaire for Older Children (PAQ-C) is a self-administered 7-day recall questionnaire intended to assess habitual moderate to vigorous physical activity in children aged 9 years or older and provide a general indication of children's physical activity levels (Crocker *et al.*, 1997; Kowalski *et al.*, 1997). Physical activity is defined as "sports, games or dance that make you breathe hard, make your legs feel tired, or make you sweat". It was originally developed to be used three times over the course of a year, with an average score derived from the three time-period scores, in order to take account of seasonal variation in activity levels. The questionnaire consists of nine questions, each with a 5-category response scale, which are used to calculate a summary activity score. Responses are averaged to give a mean score ranging from 1 to 5. For item 5 (see below) a mean score is first calculated from the 15 individual items and then combined with the responses to the other eight questions. Reliability was assessed by Crocker and colleagues (Crocker *et al.*, 1997) among a sample of 84 boys and girls aged 9-14 years. Test-retest reliability over one week was high among both boys (r=0.75) and girls (r=0.82).

A number of adaptations were made to the original PAQ-C scale for use in the present study. These included:

- Changing the wording and content of some of the items to improve suitability for the Scottish adolescent population. For example, the original list of activities in item 5 included a number of activities such as baseball, ice-skating and American football which were removed. A revised, shortened version was created based on findings from a study undertaken in the West of Scotland study (West & Sweeting, unpublished) as these were considered more likely to reflect the main activities and sports in which young people in Scotland may participate.
- Changing the definition of physical activity. In order to allow for consistency throughout the study questionnaire and to capture moderate-intensity activities, the definition of moderate-to-vigorous physical activity used in the HBSC study (see above) was used instead of that from the original measure.
- Excluding Question 10 relating to sickness and other events.

The revised version of the PAQ-C scale used in the current study included the following nine items:

1. **During the last 7 days, how often did you do physical activities in your free time?**
   Responses: never / 1-2 / 3-4 / 5-6 / 7 or more times.

2. **Last week, on how many afternoons after school did you do sports, dance or play games in which you were very active?**
   Responses: none / 1 / 2-3 / 4 / every afternoon.

3. **Last week, on how many evenings after school did you do sports, dance or play games in which you were very active?**
   Responses: none / 1 / 2-3 / 4 / every evening.

4. **Last weekend, how many times did you do sports, dance or play games in which you were very active?**
   Responses: none / 1 / 2-3 / 4 / 5 or more times.

5. **During the last 7 days, how often have you done the following sports or activities in your free time?**
   Cycling
   Football
   Rollerblading or skateboarding
   Walking for exercise
   Jogging or running
   Swimming lengths or widths
   Gymnastics
   Active games
   Dance
   Basketball, volleyball or netball
   Tennis, badminton or squash
   Hockey
   Golf
   Karate, judo or tae kwon do
   Other
   Responses: 0 / 1-2 / 3-4 / 5-6 / 7 or more times.

6. **How many days last week did you walk or cycle to or from school?**
   Responses: none / 1 / 2-3 / 4 / 5 days.

7. **Last week, what did you do most of the time during morning break time at school?**
   Responses: sat down / stood around / walked around a little / ran around and played quite a bit / ran and played hard most of the time.

8. **Last week, what did you normally do at lunchtime at school (besides eating lunch)?**
   Responses: sat down / stood around / walked around a little / ran around and played quite a bit / ran and played hard most of the time.

9. **During your PE classes last week, how often were you very active (playing hard, running, jumping, throwing)?**
   Responses: don't do PE / hardly ever / sometimes / often / always.

Principal component analysis was undertaken on the 9 PAQ-C items using data from Primary 7 and S2 pupils. Principal component analysis is a data reduction procedure used to determine the factors that maximise the explained variance in the observed variables (Biddle *et al.*, 2001) when no assumptions are made about the underlying structure. Three main components with an eigenvalue greater than 1.00 were identified (Tables 10.1 and 10.2), accounting for 35%, 15% and 11% of the variance respectively in P7 and 38%, 15% and 11% of the variance respectively in S2. PAQ-C items 1-5 loaded most strongly onto Component 1. All these items relate to physical activity during young people's free time and therefore this component can be interpreted as a dimension of leisure time physical activity. The two items relating to activity during school break times loaded most strongly onto Component 2. Component 3 appears primarily to represent active travel to school. Activity during PE also loaded most strongly onto Component 3 in P7 but not in S2.

Table 10.1: Component loadings for items from PAQ-C (long form) among P7 pupils (n=948)

	Component 1	Component 2	Component 3
1. PA during free time in last 7 days	.71	-.10	-.03
2. PA during afternoons last week	.79	-.16	-.13
3. PA during evenings last week	.73	-.29	-.08
4. PA during last weekend	.73	-.16	-.12
5. Participation in individual activities	.73	-.18	.04
6. Active travel	.11	-.07	.85
7. Morning break activity	.41	.77	.03
8. Lunchtime activity	.41	.76	-.09
9. Active during PE	.32	.09	.51
Eigenvalue	3.17	1.35	1.03
% variance explained	35.18	14.98	11.42

Table 10.2: Component loadings for items from PAQ-C (long form) among S2 pupils (n=960)

	Component 1	Component 2	Component 3
1. PA during free time in last 7 days	.78	-.08	-.07
2. PA during afternoons last week	.79	-.15	-.11
3. PA during evenings last week	.79	-.20	-.13
4. PA during last weekend	.79	-.11	-.08
5. Participation in individual activities	.70	-.16	.08
6. Active travel	.04	-.25	.93
7. Morning break activity	.33	.80	.07
8. Lunchtime activity	.39	.76	.18
9. Active during PE	.44	-.03	.27
Eigenvalue	3.44	1.38	1.01
% variance explained	38.22	15.34	11.22

The appearance of three components within the scale is perhaps not surprising given that the scale was developed to measure all aspects of physical activity across a child's day. The nine items reflect a range of opportunities for physical activity over which a child would have varying degrees of control, ranging from school physical education classes which are compulsory for most children to leisure-time activity over which most children would have some degree of choice. This degree of control or volition appears to be reflected in the results of the principal components analysis and is an important distinction to make. It is probable that the determinants of physical activity vary depending on the degree of control or choice involved and therefore it can be argued that these different components should be considered independently. The correlation matrices for the 9-item PAQ-C scale showing greater correlations between the first five items relating to leisure time activity compared with the other items in the scale are shown in Appendix 3.

In the current study, the area of greatest interest relates to determinants of physical activity during children's leisure time. Within a school setting, a number of constraints exist which are likely to affect the way in which physical activity is determined. Therefore it was decided to exclude the items relating to school-based activity from the scale for the purposes of this study. Potential differences in influences on volitional versus non-volitional physical activity in children and adolescents are worthy of further exploration but this is not the focus of the current analyses.

Selection of PAQ-C short form as outcome measure

Taking into account the advantages and disadvantages of the potential outcomes measures discussed above, and results of the principal components analyses for the 9-item version of PAQ-C, it is therefore proposed that a shortened version of the PAQ-C scale, including only the first five items, be used as the outcome measure. Further principal components analysis using only these five items revealed that all load highly onto one component, accounting for 58.1% of the variance among P7 pupils and 63.4% of the variance among S2 pupils (Appendix 4). Internal reliability for the 5-item scale showed an alpha coefficient of 0.80 and 0.84 for the P7 and S2 sample, respectively (Appendix 5).

Differences between the 5-item PAQ-C scale and other physical activity measures

Table 10.3 shows the relationship between PAQ-C (short form) scores and five other physical activity measures including, MVPA, VPA and sports club membership. Comparison of mean PAQ-C scores was undertaken using independent samples t-tests. As shown in the table, significantly higher PAQ-C mean scores were observed in the active groups compared with less active groups on each of the alternative physical activity measures. This provides evidence of the construct (convergent) validity of the PAQ-C measure.

Table 10.3: PAQ-C 5-item scale and other physical activity measures: mean score (SD) by year and gender

	Mean PAQ-C score (sd)			
Physical activity measures	**BOYS**		**GIRLS**	
	P7	**S2**	**P7**	**S2**
MVPA	n=444	n=489	n=508	n=544
5 or more days per week	3.7 (0.7)	3.7 (0.6)	3.6 (0.7)	3.3 (0.7)
Less than five days per week	2.8 (0.7)	2.7 (0.7)	2.6 (0.7)	2.4 (0.6)
p value[$]	*<0.001*	*<0.001*	*<0.001*	*<0.001*
VPA frequency	n=457	n=494	n=523	n=545
4 or more times a week	3.5 (0.7)	3.4 (0.7)	3.2 (0.7)	3.0 (0.7)
Less than 4 times a week	2.6 (0.7)	2.5 (0.6)	2.5 (0.7)	2.3 (0.6)
p value[$]	*<0.001*	*<0.001*	*<0.001*	*<0.001*
VPA duration	n=455	n=491	n=524	n=545
2 or more hours a week	3.4 (0.7)	3.2 (0.7)	3.0 (0.8)	2.8 (0.7)
Less than 2 hours a week	2.8 (0.8)	2.5 (0.8)	2.6 (0.7)	2.2 (0.7)
p value[$]	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Member of community sports club	n=453	n=495	n=524	n=548
Yes	3.3 (0.8)	3.3 (0.8)	3.0 (0.8)	2.8 (0.7)
No	2.9 (0.8)	2.8 (0.8)	2.7 (0.8)	2.4 (0.7)
p value[$]	*<0.001*	*<0.001*	*<0.001*	*<0.001*
Member of school sports club	n=454	n=483	n=523	n=546
Yes	3.3 (0.8)	3.3 (0.8)	2.9 (0.7)	2.9 (0.7)
No	2.9 (0.8)	2.9 (0.8)	2.7 (0.8)	2.4 (0.7)
p value[$]	*<0.001*	*<0.001*	*<0.001*	*<0.001*

[$] Difference in mean scores assessed using independent samples t-test.

Chapter 11

Measurement of Independent Variables

11.1 Introduction

This chapter provides details of all explanatory variables included in this study. Potential variables for inclusion were first identified through a comprehensive search of the literature. Based on a review of relevant papers, variables were included in the study if they (a) had previously shown a consistent relationship with physical activity in children or adolescents or (b) were theoretically plausible as potential influences on childhood physical activity. Most of the psychosocial variables included in the study fall into the first category, as these were found to be the focus of the majority of studies previously undertaken in this area. When this study began, less work had been undertaken to examine the role of environmental and developmental factors on physical activity in children and adolescents, but these were considered promising areas for research based either on findings in the adult literature or on current health behaviour theories. The difference in the extent to which these factors had been examined previously was reflected in the availability of valid scales and items. It was relatively easy to identify psychosocial measures that had already been validated for use within the adolescent population (although few had been used in Scotland). Although developmental factors had rarely been explored in relation to physical activity, specific measures had been used within the Scottish population in other health-related studies, such as the Health Behaviour of School-aged Children (HBSC) study (Currie *et al.*, 2002). In contrast, a search of the literature found very few environmental measures for use with children and adolescents. As a result, many of these were developed specifically for the study or adapted from other sources. The individual items are described below and the psychometric properties of measures are presented in Appendices 4 and 5.

11.2 Measurement of psychological variables

Ten psychological variables were included in the study to assess attitudes towards physical activity and self-perceptions. Attitudinal factors assessed were enjoyment, current intention, perceived benefits and perceived barriers. With the exception of one measure of global self-esteem, self-perceptions were situation-specific, i.e. relating specifically to physical activity or the physical self, and included exercise self-efficacy, perceived sports competence, physical self worth, body image and body satisfaction. Details of how each of these constructs was measured are given below.

Enjoyment of physical activity was measured using a single item, 'How much do you enjoy doing physical activity?' Response options were: a lot, a little, not very much and not at all. Based on the distribution of the data, a binary variable was created so that pupils were categorised as high enjoyment (enjoy physical activity a lot) or low enjoyment (enjoy physical activity a little, not very much or not at all).

Current intention to be active was measured with a single item used by Saunders *et al.* (1997) and adapted from a similar measure developed by Godin and Shephard (1986). Two week test-retest reliability of the original measure was high (r=0.87). Pupils were asked to tick one of five responses to the statement 'At the moment, on most days during my free time…'. The response categories were as follows:

- I am sure I will not be physically active
- I probably will not be physically active
- I may or may not be physically active
- I probably will be physically active
- I am sure I will be physically active

Based on the distribution of the data and preliminary analyses of the relationship between the five response groups and the dependent variable, a binary variable was created. Pupils were categorised as high intention (sure I will be active) or low intention (probably will be, may or may not be, probably will not be, sure I will not be).

Perceived benefits were measured using a 9-item scale which was developed for the PASS study. The items were derived from existing scales and findings from previous research identified through the literature review. Each item represented a reason why people may do physical activity and respondents were asked to say how true each one was for them. Examples included: having fun, looking better and being healthy. Response categories were: very true, quite true, not very true, not at all true. A mean score (range 1-4) was created by summing and averaging the responses to the nine items, where 1 represents low perceived benefits and 4 represents high perceived benefits. Based on the full dataset, principal components analyses revealed one component in P7 with an eigenvalue of 3.43 which accounted for 38.16% of the variance. In S2, two components were identified with eigenvalues of 3.97 and 1.10, respectively. However, only two items loaded more highly onto Component 2 ('helps me cope with stress' and 'make new friends'). Therefore, the scale was kept unchanged. Cronbach's alpha was 0.78 in P7 and 0.79 in S2.

Perceived barriers were measured using a 9-item scale which was developed for the PASS study. The items were derived from existing scales and findings from previous research identified through the literature review. Each item represented a reason why people may not take part in physical activity and respondents were asked to say how true each one was for them. Examples included: lack of time, difficulty getting to places to be active and feeling embarrassed when doing physical activity. Response categories were: very true, quite true, not very true, not at all true. A mean score (range 1-4) was created by summing and averaging the responses to the nine items, where 1 represents low perceived barriers and 4 represents high perceived barriers. Principal components analyses on P7 and S2 data both revealed two components. Component 1 had eigenvalues of 3.60 and 4.13, and accounted for 40.00% and 45.85% of the variance, respectively. Component 2 had eigenvalues of 1.08 and 1.02, and accounted for 12.02% and 11.37% of the variance, respectively. There was no clear distinction between the two components and only one item loaded more highly onto Component 2 ('too much homework', S2 only). Therefore the scale was kept unchanged. Cronbach's alpha was 0.81 in P7 and 0.85 in S2.

Previous research suggests that the relative balance *between* benefits and barriers is more important than either variable alone. Therefore, following the example of Garcia *et al.* (1998), a ***perceived benefits/barriers differential*** score was developed for this study. Perceived benefits and perceived barriers were combined to create a new construct called the 'benefits-barriers differential' which essentially represents a personal cost-benefits analysis. This was computed by subtracting the perceived barriers score from the perceived benefits score, thus creating a new variable with values ranging from -3 to +3, where a score of -3 reflects low perceived benefits and high perceived barriers and a score of +3 reflects high perceived benefits and low perceived barriers.

Exercise self-efficacy was measured using the Children's Physical Activity Self-Efficacy Survey, an 8-item scale developed by Garcia *et al.* (1998). Here, exercise self-efficacy is conceptualised as a person's confidence in their ability to be physically active in the face of certain barriers. The eight items represent a range of barriers including feeling tired, competing priorities, lack of skill and having had a bad day at school. Response categories were: very true, quite true, not very true, not at all true. A mean score (range 1-4) was created by summing and averaging the responses to the nine items, where 1 represents low self-efficacy and 4 represents high self-efficacy. Based on the full sample in P7 and S2, principal components analyses revealed one component with an eigenvalue of 3.36 (P7) and 3.72 (S2), accounting for 42.01% and 46.54% of the variance, respectively. Two components were identified for S2 boys but only one item ('if I had to exercise on my own') loaded higher onto the second component and this was only marginal. Cronbach's alpha for the full scale was 0.80 in P7 and 0.84 in S2.

Perceived sports competence was assessed using the physical ability subscale of the Self Description Questionnaire 1 (SDQ1, Marsh, 1990). This is a theoretically-based, well-validated instrument which is designed for use with the early adolescent age group (Marsh, 1997). The physical ability scale consists of eight items measuring subjective assessments of athletic competence, for example, 'I can run fast', 'I am good at sports' and 'I am good at throwing a ball'. Response categories were adapted from the original version in order to maximise consistency throughout the PASS questionnaire. Thus a 4-point likert scale was used with the following response options: very true, quite true, not very true, not at all true. A mean score (range 1-4) was created by summing and averaging the responses to the eight items, where 1 represents low perceived competence and 4 represents high perceived competence. Based on the full sample in P7 and S2, principal components analyses revealed one component with an eigenvalue of 3.94 (P7) and 4.67 (S2), accounting for 49.29% and 58.34% of the variance, respectively. Cronbach's alpha was 0.85 in P7 and 0.90 in S2.

Self-esteem was assessed using a ten-item scale, based on the Rosenberg self-esteem scale (Rosenberg, 1965). This scale had previously been adapted for use among Scottish adolescents by West & Sweeting (1997) who adapted some of the original wording to make it more culturally appropriate for adolescents within a Scottish context. The scale consists of ten items with a 4-point likert response scale ranging from 'agree a lot' (1) to 'disagree a lot' (4). Six of the items are expressions of positive self-esteem, for example, 'I am pretty sure of myself' and 'I am able to do things well'. Four items reflect negative self-esteem, for example, 'I often wish I was somebody else' and 'There are a lot of things about myself that I would like to change'. A mean score (range 1-4) was created by summing and averaging responses to all ten items. Positive items were reverse-scored so that high scores indicate high self-esteem. Principal components analyses on P7 and S2 data both revealed two components. However, Component 2 appeared to reflect the fact that the items in this scale are differentiated into positive and negative statements. With one (marginal) exception, all items loaded more highly onto Component 1 in both P7 and S2. For this reason, and because the scale is well-established and widely used, it was kept unchanged. Cronbach's alpha was 0.80 in P7 and 0.88 in S2.

Physical self worth is conceptualised as a component of global self concept relating specifically to perceptions of self in the physical domain. It was measured using the global physical self worth subscale from the Child and Youth Physical Self-Perception Profile (CYPSPP), adapted by Whitehead (1995) from the original PSPP developed by Fox (Fox, 1990; Fox & Corbin, 1989). A number of studies have subsequently confirmed the validity and reliability of the CYPSPP (Eklund *et al.*, 1997; Hagger *et al.*, 1998; Welk *et al.*, 1997) including among children as young as 8-12 years old (Welk & Eklund, 2005).

The scale consists of six items in total, four of which represent positive self worth and two of which represent negative self worth. Examples include, 'I feel confident about myself physically' and 'I don't have much to be proud of physically'. During piloting of the questionnaire the original structured alternative response format, which is based on that used in Harter's self concept instruments (e.g. Harter, 1985) and designed to reduce social desirability responding, was found to be difficult for P7 pupils to understand. Previous research has also found this response structure to be problematic for children (Marsh & Gouvernet, 1989) and others have found that responses to Harter's Self-Perception Profile for Adolescents were psychometrically stronger when based on typical Likert responses rather than the structured alternative format (Wichstrom, 1995). Therefore, response options were changed to a 4-point likert scale ranging from very true (1) to not at all true (4), in line with other items in the questionnaire. A mean score (range 1-4) was created by summing and averaging responses to all ten items. Positive items were reverse-scored so that high scores indicate high physical self worth.

Principal components analyses on P7 and S2 data revealed two components. However, these appeared to reflect the fact that the items in this scale are differentiated into positive and negative statements, with the four positive items loading more highly on to Component 1 and the two negative items loading more highly on to Component 2. For this reason, and because the scale has previously been well validated, it was kept unchanged. Cronbach's alpha was 0.80 in P7 and 0.87 in S2.

Body image was assessed using a single item, from the HBSC survey (Currie *et al.*, 2002). Pupils were asked 'Do you think your body is....?' Response options were: much too thin / a bit too thin / about the right size / a bit too fat / much too fat. The responses were first recoded to create three categories: (1) 'too thin' (much too thin & a bit too thin), (2) 'about right' and (3) 'too fat' (much too fat & a bit too fat). Two dummy variables were then created for use within regression analyses, with group 2 as the reference category. Test-retest reliability for this item has previously been assessed among a sample of Belgian adolescents; 71% of respondents selected the same category on both occasions and 16% gave an adjacent answer with an overall kappa score of 0.6 (Maes *et al.* 2002).

Body satisfaction was assessed using body silhouettes for children and adolescents (Wardle *et al.*, 1995; Collins, 1991). These consist of a set of figure drawings representing a range of body shapes from thin to obese and are used to assess ideal and perceived body shape. The discrepancy between these two measures provides an indicator of body satisfaction. Responses were categorised into three groups: (1) satisfied with body shape (2) would like to be thinner (3) would like to be bigger. From these three categories, two dummy variables were created for use within regression analyses, with group 1 (satisfied with body shape) as the reference category.

11.3 Measurement of developmental variables

As discussed in Chapter 3, there is interest in exploring the relationship between maturational status and physical activity as the decreases in physical activity participation observed among early adolescents tend to coincide with the periods of pubertal development. Two variables measuring maturational status were therefore included in the PASS study.

Pubertal development was assessed using a single item which has been used previously in the HBSC study (Currie *et al.,* 2002). It is a measure of perceived pubertal timing and represents a child's perception of their own stage of physical development relative to their peers. It has been shown to accurately assess perceptions of pubertal timing (Dubas *et al.,* 1991). Pupils were asked: 'Do you think your physical development is any earlier or later than most other boys/girls your age?'. Responses were: much earlier, somewhat earlier, about the same, somewhat later, much later. Responses were subsequently recoded into three categories: 'early' (somewhat earlier and much earlier), 'on-time' (about the same), and 'late' (somewhat later and much later) development. Two dummy variables were then created for use in multiple regression analyses with 'on-time' development as the reference group.

Menarche was also used to assess developmental maturation in girls. This has previously been shown to be a reliable indicator of puberty in girls (Ge *et al.*, 2002). Girls were asked if they had 'begun to menstruate (have periods)'. Those who responded that they had were then asked to state the month and year in which they began. Two variables were derived from this item; (current) *menarcheal status* and *menarcheal timing* (relative menarcheal status). Menarcheal status is a binary variable based on girls' responses to the initial question; those who had begun menstruating were classified as post-menarcheal and those who had not were classified as pre-menarcheal. Menarcheal timing is a measure of maturational status relative to one's peers which was derived from the year and month of onset of menstruation. Girls for whom menarche occurs before age 12 are categorised as early and those for whom it occurs later than age 13 are categorised as late (Currie & Nemeth, 2004). Thus, those girls in P7 who had begun menstruating were categorised as early developers and those who had not yet begun were categorised as on-time relative to their peers.

11.4 Measurement of social variables

Seven social variables were included in the study. These were used to assess various aspects of young people's social context including family and peer influences. Within the family, measures of composition and material wealth were used as well as support for physical activity from parents and older siblings. Two factors relating to peer culture were assessed: time spent with friends after school (peer socialising) and peer support for physical activity.

Family structure was assessed using an item developed for the HBSC study (Currie *et al.*, 2002). This new item was developed for the 2001/02 international survey to take account of the social changes which have led to increasingly diverse composition of families throughout Europe and North America. For the first time within the HBSC questionnaire, it provided children with an opportunity to describe who they live with in their main home and in a second home where they may also live some of the time. The question aims to be sensitive to the complexity of family structures in which many young people live and to capture information on these (Pedersen *et al.,* 2002).

The question is designed in two columns, one for each home and includes a checklist of people with whom the child may live in each: parents, stepparents, siblings, members of the extended family and / or other adults. There is also an option for children living in a foster home or children's home. For the purposes of the current study, four family structure categories were derived, using responses to the main home as a reference for these. The four categories were as follows: living with both parents, single-parent family, stepfamily or other.

Family affluence was used as an indicator of the socio-economic status of pupils. The Family Affluence Scale (FAS) is a validated self-report measure of material affluence based on items derived from the characteristics of a child's household which children and adolescents can easily answer (Currie *et al.*, 1997; Currie *et al.,* 2008). It was first devised and used in the 1989/1990 HBSC survey in Scotland to overcome the problem of missing data on parental occupation questions and has subsequently been adopted for use internationally within the HBSC study. Using FAS, previous research has shown relationships between family affluence and health at an individual and aggregate level (Currie *et al.*, 2008). Material wealth is associated with children and adolescents' health-related quality of life (von Rueden *et al.*, 2006) and subjective health (Torsheim *et al.*, 2006).

Three items from the Family Affluence Scale (FAS) were included as follows:

1. Does your family own a car, van or truck? *(no / yes, one / yes, two or more)*
2. Do you have your own bedroom for yourself? *(no / yes)*
3. During the past 12 months, how many times did you travel away on holiday with your family? *(not at all / once / twice or more)*

Item 1 is a component of a Scottish deprivation index developed by Carstairs and Morris (Carstairs & Morris, 1991) which is used widely in research on health inequalities. Item 2 is a simple proxy for overcrowding, classified by Townsend as housing deprivation (Townsend, 1987), and is also a component of the Scottish deprivation index. Item 3 is a measure of deprivation in home facilities (Townsend, 1987). An additional item on computer ownership was not used for analyses in the current study as there was a significant gender difference in this item which could have influenced the gender distribution of FAS scores and subsequent associations with physical activity.

Responses to the three items above were summed to give a total FAS score, ranging from 0 to 5. Respondents were then categorised as low, medium or high FAS where FAS1 (score=0-2) indicates low family affluence, FAS2 (score=3,4) indicates medium family affluence and FAS3 (score=5) indicates high family affluence. Two dummy variables were then created for use in multiple regression analyses with low FAS as the reference group.

Paternal and maternal support for being active were assessed separately using questions adapted slightly from a scale previously developed by Sallis and colleagues as part of the Amherst Health and Activity Study (Sallis *et al.*, 2002b; Prochaska *et al.*, 2002). Test-retest reliability of the original version was found to be strong (ICC=0.88) and there were significant correlations between parent and child reports (Sallis *et al.*, 2002b).

The scale consists of five items and respondents were asked to state how much their mother or father does each of the following:

1. Encourage you to do physical activities
2. Do physical activities with you
3. Provide transport to a place where you can do physical activity
4. Watch you do physical activity
5. Praise you for doing physical activity

Frequency of support was rated on a 4-point likert response scale ranging from *not at all* to *a lot*. Responses were reverse-coded so that higher scores represent higher levels of support. Pupils who do not have or not do see their father or mother were asked to tick separate boxes. A mean paternal / maternal support score (range 1-4) was then calculated by averaging the responses to the five items.

For the paternal support scale, principal components analyses revealed one component with an eigenvalue of 2.98 (P7) and 3.23 (S2), accounting for 59.60% and 64.64% of the variance, respectively. Cronbach's alpha was 0.83 in P7 and 0.86 in S2. Principal components analyses for the maternal support scale revealed one component with an eigenvalue of 2.47 (P7) and 2.70 (S2), accounting for 49.32% and 54.01% of the variance, respectively. Cronbach's alpha was 0.74 in P7 and 0.78 in S2.

Mean paternal / maternal support scores were then categorised into two groups, 'high' and 'low' support, based on the median value for the whole sample in wave 1 of data collection (P7). Cases with a score less than the median value were categorised as 'low support' and cases with a score equal to or greater than the median value were categorised as 'high support'. In order not to exclude those pupils who said that they do not have or do not see their father and/or mother, two new social support variables were created, each consisting of three groups as follows:

- no father / mother (do not have or do not see father / mother)
- low support (mean score below median value)
- high support (mean score equal to or above median value)

Dummy variables were then created for use in multiple regression analyses with low support as the reference group.

Older sibling support for physical activity was assessed using a shorter version of the scale used for parental support. Given the age of the respondents, it was presumed unlikely that many would have older brothers or sisters who were themselves old enough to provide transport for younger siblings. Therefore, item 3 was excluded from the scale. A mean sibling support score (range 1-4) was calculated by averaging responses to the four remaining items. Responses were first reverse-coded so that higher scores represent higher levels of support. Pupils who do not have or not do see an older sibling were asked to tick a separate box.

Principal components analyses on P7 and S2 data both revealed one component with an eigenvalue of 2.76 (P7) and 3.02 (S2), accounting for 69.03% and 75.47% of the variance, respectively. Cronbach's alpha was 0.85 in P7 and 0.89 in S2.

The mean sibling support score was categorised into two groups, 'high' and 'low' support, based on the median value for the whole sample in wave 1 of data collection (P7). Cases with a score less than the median value were categorised as 'low support' and cases with a score equal to or greater than the median value were categorised as 'high support'. In order not to exclude those pupils who said that they do not have or do not see an older sibling, a new social support variable was created with three groups as follows:

- no older sibling (do not have or do not see older sibling)
- low support (mean score below median value)
- high support (mean score equal to or above median value)

Two dummy variables were then created for use in multiple regression analyses with low support as the reference group.

Peer support was measured using two items adapted from the Amherst Health and Activity Study[f]. Pupils were asked how much their friends (1) encourage them to do

[f] www.drjamessallis.sdsu.edu/amhersthealthandactivitystudystudentsurvey.pdf

sports or physical activities and (2) do sports or physical activities with them. Frequency of support was rated on a 4-point likert response scale ranging from *not at all* to *a lot*. Responses were reverse-coded so that higher scores represent higher levels of support. A mean score was created by averaging responses to the two items (range 1-4) with low values reflecting lower peer support and high values reflecting higher peer support.

Peer socialising was assessed using two items from the HBSC survey (Currie *et al.*, 2002) which ask about the frequency of time normally spent with friends after school and in the evenings. Pupils were asked how many days a week they usually spend time with friends (1) after school and (2) in the evenings. There were six response options ranging from 0 to 5 days. The items referred only to school days; weekends were excluded. A mean peer socialising score was created by averaging responses to the two items.

11.5 Measurement of environmental variables

Five variables measuring aspects of the socio-physical environment were included in the study: availability of local facilities for sport and physical activity, accessibility of local facilities, perceptions of the local neighbourhood, perceptions of neighbourhood safety and amount of sports equipment at home. It should be noted that, while some of these relate to quantifiable characteristics of children's physical environment, all the measures are 'subjective' in the sense that they are based on respondent's perceptions.

Perceptions of the local neighbourhood were measured using an item from the HBSC study (Currie *et al.*, 2002). Respondents were asked to what extent the following are present in the area where they live:

- Groups of young people who cause trouble
- Groups of adults who cause trouble
- Litter, broken glass or rubbish lying around
- Run-down houses or buildings

Response categories were 'none', 'some' or 'lots'. Responses were reverse-coded so that higher scores represent more positive perceptions of the local neighbourhood. A mean score (range 1-3) was computed by averaging the responses to the four items. Principal components analyses on P7 and S2 data revealed one component with an eigenvalue of 2.12 (P7) and 2.44 (S2), accounting for 53.10% and 60.97% of the variance, respectively. Cronbach's alpha was 0.70 in P7 and 0.79 in S2.

Neighbourhood safety was assessed using two items from the Amherst Health and Activity study[g] which were adapted slightly in order to make the language more appropriate for use with adolescents in a Scottish context. These items measure perceptions of safety in relation to physical activity, specifically walking and cycling:

1. It is safe to walk or cycle alone during the day in the area where I live
2. It is difficult to walk or cycle in the area where I live because of things like traffic, no pavements, dogs, gangs, etc.

Responses were rated on a 5-point likert scale ranging from 'agree a lot' to 'disagree a lot'. Item 1 was reverse-coded so that higher values represent perceptions of higher safety. A mean neighbourhood safety score (range 1-5) was then computed by averaging the responses to the two items.

Availability of local facilities for sport and physical activity was measured using a question developed specifically for the PASS study. Pupils were asked which of the following facilities they have in the area where they live: sports centre, playing field, park, swimming pool, basketball courts or hoops, tennis courts. Responses were 'yes', 'no' and 'don't know'. The 'yes' responses were summed to create a total availability score with a range from 0-6.

Access to local facilities for sport and physical activity was measured using a question developed specifically for the PASS study. Pupils were asked how easy it is for them to get to the following facilities: sports centre, playing field, park, swimming pool, basketball courts or hoops, or tennis courts. Responses ranged from

[g] http://www.drjamessallis.sdsu.edu/amhersthealthandactivitystudystudentsurvey.pdf

'very easy' to 'not at all easy' and included a 'don't know' option. The 'very easy' and 'quite easy' responses were combined and then summed to create a total access score with a range from 0-6.

Home equipment was assessed using a question developed specifically for the PASS study. The question aimed to provide an indication of the amount of sports and games equipment available within the home. Pupils were asked if they had any of the following pieces of sports and games equipment at home: bicycle, balls, racquets, rollerblades or skates, skateboard, skis or snowboard, or weights. In addition there was one 'other' option and respondents were asked to specify which other piece(s) of equipment they have at home. The following 'other' responses given by P7 pupils were excluded: darts, horses and dogs, snooker cue, motorbike, cones for football, snooker table. The following 'other' responses were excluded in S2: pool table, snooker table, bingo, big garden at home, jacuzzi, motorbike, jet ski, fishing rod, games, hovercraft, house and goggles. If none of the eight options were ticked, cases were excluded from further analyses. A total home equipment score (range 1-8) was computed based on the number of 'yes' responses.

Chapter 12

Data preparation and statistical analyses

12.1 Introduction

This chapter describes the processes involved in data management and analysis at all stages of the study. The data presented in this thesis represent two waves of data from the PASS study (P7 and S2). Once the data were collected, data entry was undertaken by an external agency before being returned to the research team. This chapter focuses specifically on processes following on from data entry, including data cleaning and preparation, dealing with missing data, descriptive statistics, correlation and regression analyses. The techniques used to take account of possible clustering effects resulting from pupils being nested within schools are described. All analyses were undertaken using SPSS versions 12-14 and MLWin version 1.1.

12.2 Data cleaning and preparation

Any specific queries arising at data entry stage were highlighted by the external agency responsible for data entry and these were dealt with individually as soon as the data were returned by cross-checking with responses on the original questionnaires. Frequencies were run on all variables to check for out-of-range data values. Where these were found, they were corrected with reference to the original questionnaires.

With continuous data it is important to check for outliers as these can affect the results of statistical analyses, especially in regression analyses. Typically, outliers are extreme values which differ from the rest of the data. Outliers can also result from coding errors so this process provides a secondary check on data entry. All relevant data were checked for potential outliers but, as all the variables had restricted values, none were identified.

Dealing with missing data

There are many sources of incomplete data in behavioural research. Individuals may refuse to, or be unable to, take part in the research (missing subject). In the case of survey research, respondents may not complete all questionnaire items (missing values). In longitudinal research, an additional problem arises when measurements are not available for all participants at all time points (sample attrition). This may occur when individuals drop out of a study or are unavailable to provide data at specific time points. Missing data can be particularly problematic when research is conducted within a school setting due to school absence or transfer and the time limitations imposed by class periods. Issues associated with missing subjects and attrition are discussed further in Chapter 13. Issues associated with missing values are discussed here.

There are a number of options for dealing with missing data. It is possible to exclude all respondents with missing values from the relevant analyses. However, if too many cases are excluded, the representativeness of the sample may be compromised and the power of the analyses may be reduced. More commonly, a form of imputation is used whereby known relationships that can be identified in the valid values of the sample are used to assist in estimating the missing values (Hair *et al.*, 1998). There are different mechanisms by which missing data may occur, and this is reflected in the patterning of missing values within a dataset. Data may be considered to be missing at random when the probability that a value is missing is not dependent on the score for any other variable in the dataset. Conversely, non-random missing data is where the probability of a missing value is related to one or more of the independent variables in the dataset. Data that are missing at random are more amenable to substitution techniques than missing data which is non-randomly patterned (Downey & King, 1998).

Missing data are a frequent problem when scales are used to measure constructs because respondents often fail to complete all the items within the scale. Missing values within scale items are a unique case of missing data. Unlike variables within a dataset, items within a scale are designed to measure different aspects of the same construct and are selected for inclusion in the scale based on the degree to which they correlate with the total score of all other items in the scale. For this reason, the standard procedures recommended for managing missing data in datasets are less appropriate for use with scales. These include item mean imputation, whereby the missing value is replaced with the sample mean for that specific item, and regression imputation, whereby the missing value is substituted by a predicted value based on the regression of other known variables onto the missing variable. While there is much discussion in the literature of these methods for dealing with missing variables within datasets, very little guidance appears to be available for dealing with missing values for items within a scale. Given the number of scales used within the PASS study, an attempt was made to find an appropriate way of dealing with this issue.

Downey & King (1998) suggest that a method called 'person mean substitution' (PMS) may provide one such technique as an alternative to other forms of imputation. Using the PMS approach, the missing value is replaced by the mean value of all the items within the scale for that individual. In an investigation of the effects of using the PMS method, Downey found that it provided a good representation of the original data if the percentage of cases with missing items and the number of missing items within the scale was less than 20%. Furthermore, when these criteria were met, the PMS method produced similar results compared with when the more common item mean imputation method was used but avoided some of the disadvantages associated with this such as underestimation of the true variance in the data. Katz (2006) recommends an equivalent technique whereby a mean score for each subject is calculated by averaging the responses to the number of valid items. Katz advises that, for this method, at least half the variables within each scale should have complete data.

It is clear that there is no one ideal or agreed method for dealing with missing data. For the purposes of the current study, the technique recommended by Katz (2006) was adopted. Using this method, the mean score is the same as if the person mean substitution method were used. This decision was made on the basis that an individual's responses to scale items would be likely to provide a more accurate representation of their score than imputing the mean value of the sample as a whole. Taking advice from the literature, a 25% cut point was decided on so that only cases with more than 25% missing values were excluded from analysis. For non-scale items, cases with missing values were excluded from the analysis. The only exception was for the social support scale items where it would have been detrimental to the analysis to exclude those who did not respond to these items because they do not have or do not see their mother, father or older sibling. For these measures, therefore, categorical variables were created to include all possible cases.

12.3 Data analysis strategy

The aim of the analyses was to develop a model of the determinants of physical activity among early adolescents using longitudinal data collected in the PASS study. A total of 22 explanatory variables, described in Chapter 11, were selected for inclusion in the analyses based on previous evidence suggesting a potential association with physical activity behaviour. Several stages of data analyses were carried out to develop a final integrative model of physical activity determinants. These were as follows:

- Descriptive analysis of physical activity and explanatory variables including gender differences and changes over time
- Testing for associations between explanatory variables and physical activity
- Model building stage 1: cross-sectional analyses and development of three separate models (1) psychological (2) social (3) environmental
- Model building stage 2: cross-sectional analyses and development of an integrated model combining significant variables from previous stage 1
- Model building stage 3: longitudinal analyses and development of model of predictors of physical activity across the primary-secondary school transition

Based on findings from previous studies, it was hypothesised that determinants of physical activity would vary by gender and therefore analyses should be conducted separately for boys and girls. In order to test this hypothesis, regression analysis was carried out for all psychological variables including gender as an interaction term to check for gender differences in the associations between psychological factors and physical activity. Among P7 pupils, there was a significant interaction between gender and perceived competence and current intention. Among S2 pupils, there was a significant interaction between gender and perceived competence, self-efficacy and the perceived benefits-barriers differential. This indicates that gender moderates the relationship between certain psychological factors and physical activity and therefore all subsequent analyses were undertaken separately for boys and girls. For all variables, results are presented by year and gender.

12.4 Descriptive analyses

Basic descriptive analyses were undertaken on all variables. Data were screened visually to check for normality using histograms and normal plots. No transformations of the data were necessary. Gender differences were assessed using chi-squared test for categorical variables or independent samples t-test for continuous variables. Age differences are represented by changes over time; changes in the dependent and independent variables between wave 1 (P7) and wave 2 (S2) were assessed using chi-squared test for linear trend for categorical variables. For continuous variables which were normally distributed, a paired samples t-test was used; for all other continuous variables, a wilcoxon signed rank test was used to assess change over time. Differences are reported as significant at the $p<0.05$ level.

12.5 Associations between explanatory variables and physical activity

The relationships between the dependent variable, PAQ-C mean score, and categorical explanatory variables were assessed using an independent samples t-test (for binary variables) or a one-way analysis of variance (for variables with three or more categories). The relationships between PAQ-C score and continuous explanatory variables were assessed using either Pearson's or Spearman's rank correlation. According to Altman (1991), when using Pearson's *r* to calculate the correlation coefficient for any two continuous variables, it is preferable for both variables to have an approximately normal distribution. Therefore, where the explanatory variable was not normally distributed, Spearman's rank correlation was used instead of Pearson's *r*. For variables which were found to be significantly correlated with PAQ-C score, associations were further examined using linear regression analyses. Variables which were not significantly associated with PAQ-C score at this stage were excluded from subsequent analysis.

12.6 Development of models and model testing

An iterative process of model development and model testing was employed. Cross-sectional analyses were undertaken first with models run separately for P7 and S2 data. Longitudinal analyses were then undertaken to examine P7 predictors of S2 physical activity. All analyses were run separately for boys and girls. Stages of model development and testing were as follows:

Stage 1: Using multiple regression analysis, three multivariate models were developed for psychological, social and environmental factors, respectively (see Chapters 15-17). Based on the results of linear regression analyses, variables that were significantly associated with PAQ-C score in univariate analysis were included in the multivariate models. Based on the R^2 value from linear regression, variables were entered into the model one at a time, with the variable with highest R^2 value entered first. Any variable which did not significantly improve the model fit, as measured by the R^2 value (with a significance level of $p<0.05$), was removed before the next variable was entered.

Within multivariate analyses it is assumed that the effects of the explanatory variables on the dependent variable are independent i.e. the effect of one variable is the same regardless of the values of the other variables in the model (Altman, 1991).

The potential interaction between two variables can be tested by creating a new variable that is the product of the original two variables which is then added to the model. This new variable is known as an interaction term. This process, in effect, tests for *moderating* variables whereby the effect of one independent variable on the outcome variable is dependent on the value of another independent variable. Altman (1991) advises against investigating all possible interactions as this would increase the likelihood of producing a spurious result. Based on the advice of statistician colleagues, interaction effects were tested only for those variables which made the strongest contribution within each model. Interaction terms between the strongest variable and all other significant variables were created and tested for statistical significance in the model. Where a significant interaction effect was found this was retained in the model.

Stage 2: Following testing of the three separate models, combined psycho-socio-environmental models were developed (see Chapter 18). Variables which were found to be significant within the multiple regression models developed during stage 1 were entered into integrated models. Variables were added to the models in three blocks: (1) psychological variables, (2) social variables, and (3) environmental variables. Any variables which did not significantly improve the model fit, as measured by the R^2 value (with a significance level of $p<0.05$), were removed before the next set of variables were entered. This analysis was initially carried out by multiple regression analyses and then re-run using multilevel modelling in order to test for school effects. Multilevel modelling techniques are a generalisation of the linear model used in multiple regression or analysis of variance (Masse *et al.*, 2002) and are used to analyse hierarchical data. Hierarchical data structures occur when data are collected from individuals who are grouped into clusters at different levels. Within the hierarchy, units at one level are conceptualised as being nested within units at the next highest level. For example, as in the current analyses, pupils are grouped within schools. Such clustering effects need to be taken into account because of the likelihood that individuals from within the same cluster will be more similar to one another than those from different clusters.

Stage 3: In this final stage, longitudinal analyses were undertaken to investigate P7 predictors of physical activity in the early secondary school years (see Chapter 19). The outcome variable was S2 PAQ-C mean score. All P7 explanatory variables were entered into the model first to identify those which significantly predicted S2 physical activity. For the significant variables, the equivalent S2 variables were then added to the model to test whether there was an effect of P7 characteristics on S2 physical activity over and above that of the S2 characteristics. Finally, baseline physical activity was controlled for by adding P7 PAQ-C score into the model. All analyses were undertaken using multilevel modelling. Significance of the variance at the school level was tested by reference to its standard error (SE); a value greater than SE x 1.64 was deemed to be significant at the $p<0.05$ level. A one-sided test was used as a variance cannot be negative. A two-sided test was used to assess the significance of coefficients in the model, again with reference to the standard error; where the value of the coefficient was greater than SE x 1.96, it was deemed to be significant at the $p<0.05$ level.

Testing model fit

How well a model 'fits' the data, or predicts the dependent variable, can be assessed by considering the proportion of the total sum of squares that can be explained by the regression (Altman, 1991). This is expressed as an R^2 statistic. R^2 cannot be used as a criterion for deciding which variables to include in the model because it will increase with each variable added. Instead, adjusted R^2 is used as this takes account of the expected chance prediction when null hypothesis is true. Both R^2 and adjusted R^2 are measures of the correlation between the observed and predicted values of the dependent variable. However, while R^2 provides a crude measure of how well the model fits the data overall, further analysis of the residuals is necessary in order to assess how well the model predicts values of the dependent variable for individuals. Residuals reflect the difference between the observed and predicted value of the dependent variable and, therefore, represent error in the estimation. The residual standard deviation provides a measure of the average difference between observed and predicted values.

A number of assumptions are central to multivariate analyses (Altman, 1991; Miles & Shevlin, 2001). Following model estimation, analysis of the residuals provides a means of testing whether these assumptions have been met, that is, whether the errors in prediction are a result of an actual absence of relationship among the variables or are caused by characteristics of the data which are not accommodated by the regression model (Hair *et al.*, 1998). The core assumptions to be examined are as follows:

- *Linearity* - the relationship between the dependent variable and each continuous explanatory variable is linear
- *Independence* - the explanatory variables within a model are independent of each other
- *Constant variance* - the variance of the residuals at every set of values for the explanatory variable is equal (homoscedasticity)
- *Normality* - for each value of the dependent variable, the residuals are normally distributed.

Further explanation of these assumptions and the process by which they were checked for each of the regression models in the current analyses is provided below.

Linearity

Linearity represents the degree to which the change in dependent variable is associated with the independent variable. The relationship between the dependent variable and each continuous explanatory variable is assumed to be linear. That is, for each unit increase in an explanatory variable, the corresponding change in the dependent variable will be constant across all possible values of the explanatory variable. Linearity was tested by plotting the (standardised) residuals against the predicted dependent values. Partial regression plots, showing the relationship of a single independent variable to the dependent variable, were also analysed. In both cases, a curvilinear pattern indicates the existence of a non-linear relationship and corrective action, such as transformation of the explanatory variable, is needed to improve the predictive accuracy of the model and increase the validity of the estimated coefficients.

Independence

Multivariate analysis assumes that the explanatory variables are independent of each other. Collinearity is where an association exists between two explanatory variables. Where there is a high correlation between more than two explanatory variables, this is known as multicollinearity. Multicollinearity is important because the ability of an explanatory variable to improve the predictive value of a model is associated not only with its relationship to the dependent variable but is also affected by its correlation with the other explanatory variables already in the model. Where multicollinearity exists, therefore, the predictive power of an explanatory variable is reduced by the extent to which it is associated with the other explanatory variables. For the purposes of the current analyses, a number of diagnostic techniques recommended by Hair *et al.* (1998) were employed to test for multicollinearity. Firstly, the values of the tolerance and variance inflation factor (VIF) were checked. A low tolerance value and high VIF indicate a high degree of collinearity. According to Hair *et al.* (1998), a common threshold is a VIF value of 10.0 which corresponds to a tolerance of 0.10. Secondly, a collinearity diagnostics table was produced for each model in SPSS. Using this output, a problem of collinearity was indicated for any condition index with a value of 30 or more and where two or more variables have variance proportions greater or equal to 0.90.

Constant variance

Homoscedasticity refers to the assumption that a dependent variable has equal levels of variance across all values of an independent variable. This is important so that the variance of the dependent variable which is explained by an independent variable is not concentrated in only a limited range of values of the independent variable (Hair *et al.*, 1998, p.73). When this assumption is violated within multiple regression analyses, it is known as heteroscedasticity and refers to the existence of unequal variances. Heteroscedasticity can be related to sample size, particularly for highly skewed distributions where fewer cases may be represented by certain values of the independent variable. In the present study, homoscedasticity was initially assessed visually by checking the partial regression plots for each of the independent variables within the regression model. A funnel-shaped distribution is indicative of heteroscedasticity. Where this was suspected, it was tested formally using the Levene test for homogeneity of variance. This test measures the equality of variances for a single pair of variables. If the Levene test was significant, the model was re-run after log transforming the dependent variable to check for model improvement.

Normality

In a model with good fit, for each value of the dependent variable, the residuals should be normally distributed. All multiple regression analyses were therefore checked for normality of residuals using histograms and normal probability plots of regression standardised residuals. In normal probability plots, the standardised residuals are compared with the normal distribution. The normal distribution makes a straight diagonal line, and the distribution of residuals is normal if the residual line follows the diagonal.

Non-normality may be caused by the presence of outliers or influential observations. Outliers are those individuals for whom values on the outcome variable do not fit with other cases. Outliers whose values alter the parameter estimates for a model are known as influential observations. In order to check for outliers and influential observations, the residuals were carefully examined for each model. Casewise diagnostics were used to identify any cases with a standardised residual value of greater than 3 standard deviations. These cases represent individuals for whom the predicted value of the dependent variable (PAQ-C score) differs considerably from the observed value. Where these were identified, the individual cases were checked for unusual data patterns which may have an influence on the regression equation. Hair *et al.* (1998, p.236-7) provide the following guidance for dealing with potential outliers:

"The identification of influential cases is an essential step in interpreting the results of regression analyses. The analyst must be careful, however, to use discretion in the elimination of cases identified as influential. There are always outliers in any population and the researcher must be careful not to trim the data set so that good results are almost guaranteed. Yet, one must also attempt to best represent the relationships in the sample and the influence of just a few cases may distort or completely inhibit achieving this objective."

Detailed analyses of potential outliers revealed no cases where it was necessary to remove the individual case from the dataset.

Section 3

RESULTS

Chapter 13

Sample information and characteristics

13.1 Introduction

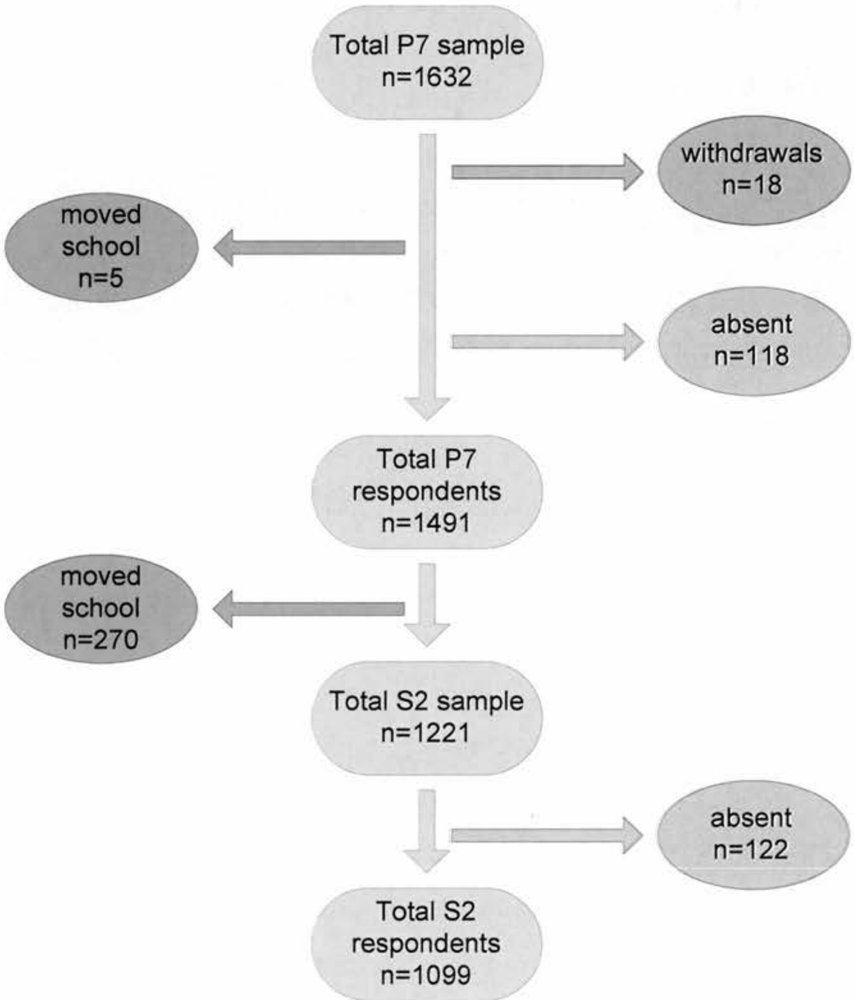
This chapter presents descriptive information about the longitudinal sample on which the analyses in this thesis are based. The sample includes all children taking part in the PASS study who completed a questionnaire in both P7 and S2. It also describes the loss-to-follow-up from the original PASS sample over the two-year period between P7 and S2 and the possible implications of this for subsequent analyses.

13.2 Study sample

The original PASS sample consisted of 1632 pupils in P7 from a total of 52 primary schools within eight school clusters. Of these, 18 were withdrawn from the study by their parents and two pupils opted out themselves. A further five pupils moved away from the study schools before the first survey was undertaken. Thus, a total of 1609 pupils were eligible for inclusion in the first survey. Of these, 1491 (92.7%) completed a questionnaire. The remaining 118 pupils were absent from school on the day of the survey and therefore were not able to complete a questionnaire.

Of the 1491 pupils for whom data were collected in P7, 1099 (73.7%) also completed a questionnaire in S2. Between P7 and S2, 270 pupils left the participating schools and 122 were absent on the day of the survey. Therefore, a total of 392 pupils (26.3%) were lost to follow up over the study period and are excluded from longitudinal analyses (see Figure 13.1). The analysis presented in this thesis is based on the longitudinal sample of 1099 pupils who completed a questionnaire in both P7 and S2. Pupils who moved away from the study schools during the project were not followed up, due to resource considerations and in order to ensure methodological consistency in the administration of questionnaires.

Figure 13.1: PASS sample showing loss-to-follow-up between P7 and S2



13.3 Loss to follow-up

Loss to follow-up is a recognised problem in longitudinal studies because of the possibility that these cases may have different characteristics from those who remain within the sample. Table 13.1 shows differences between the longitudinal and loss to follow-up groups for key demographic characteristics and PAQ-C score. There was a significant difference between the two groups for family structure, with a slightly higher proportion of two-parent families among the longitudinal sample. However, using Cohen's (1988) classification, the effect size for the difference was small (<0.2). Mean age was the same for both groups (11.3 years (SD 0.3)).

Table 13.1: Characteristics of P7 pupils for those followed to S2 (longitudinal sample) and those lost to follow-up (P7 only sample)

Characteristics	P7 only sample		Longitudinal sample			
	n	%	n	%	*p*	Effect size[a]
Gender (male)	392	49.5	1099	48.1	0.34	0.01
Family structure (2-parent)	379	62.3	1071	69.4	<0.05	0.08
Family affluence (high)	375	18.9	1065	22.4	0.22	0.05
	n	Mean (SD)	n	Mean (SD)	*p*	Effect size[b]
PAQ-C score	355	3.03 (.81)	983	2.95 (.81)	0.12	0.10

a Phi
b Cohen's *d*

13.4 Sample characteristics

A range of socio-demographic data was collected in the PASS study including gender, age, family structure, family affluence, free school meal entitlement and ethnicity. All these variables were measured in both P7 and S2 except for ethnicity and family structure which were only measured in P7. Of the 1099 pupils who completed a questionnaire at both time points, 48.1% were male and 51.9% were female. Characteristics of the longitudinal sample are shown in Table 13.2. Within each year group, the mean age was the same for boys and girls: 11.3 years in P7 and 13.6 years in S2.

In P7, pupils were asked about who they lived with most of the time. The majority of pupils said they lived with both parents, around one in five lived in a single parent household and one in ten lived in a stepfamily. These proportions are very similar to those found in a nationally representative sample of adolescents in Scotland; data from the 2001/02 HBSC survey revealed that 70% of children aged 11, 13 and 15 years lived with both parents, 17% lived in a single parent family and 12% lived in a stepfamily (Todd *et al.*, 2007). There was no gender difference in family structure. A very small proportion (1.8%) of pupils lived in 'other' types of household such as foster homes or with other relatives. Due to the small number, these pupils and twenty-eight pupils who did not answer this question were excluded from further analysis on family structure.

Table 13.2 shows the distribution of pupils across family affluence groups. Three groups are created from the composite Family Affluence Scale (FAS) score, as described previously in Chapter 11. Just over half of pupils reported medium family affluence in each year. Just under a quarter of pupils in P7, and around a fifth in S2, reported low family affluence. These figures are similar to those among the national HBSC sample where 20% of young people live in low affluence households (Levin *et al.*, 2007).

Free school meal entitlement is used as an indicator of deprivation[h]. Data from the Scottish Government[i] shows that, on a national level, the proportion of primary and secondary pupils entitled to free school meals at the time of PASS data collection was 20.3% and 16.0% respectively. Thus the PASS sample would appear to be reasonably representative of the Scottish population as a whole with respect to this specific indicator of deprivation.

Ethnicity was assessed using an item question from the HBSC study (Currie *et al.*, 2002). The vast majority of the sample described themselves as white. Other responses included: Pakistani (1.1%), Indian (0.5%), Chinese (0.4%), Bangladeshi

[h] In Scotland, pupils entitled to free school meals are those within families who receive Income Support (IS) or Income-based Job Seekers Allowance (IBJSA). Those within families who receive support under Part VI of the Immigration and Asylum Act 1999 may also be entitled. Children who receive IS or IBJSA in their own right are also entitled to receive free school meals. Also entitled are those children whose parents or carers receive Child Tax Credit, do not receive Working Tax Credit and have an annual income of below £14,155 (http://www.scotland.gov.uk/News/Releases/2007/06/05104224).

[i] http://www.scotland.gov.uk/Resource/Doc/178917/0050919.pdf

(0.1%), 'black' (0.1%). A further 0.9% of pupils ticked the 'other' category which included a range of responses, for example, Algerian, Portuguese, Russian and Polish. The number of pupils within the 'non-white' groups was too small to allow for any meaningful analyses by ethnicity.

Table 13.2: Sample characteristics

	P7 (2002)		S2 (2004)	
	boys	**girls**	**boys**	**girls**
Number of respondents	529	570	529	570
Mean age (years)	11.3	11.3	13.6	13.6
Family structure (%)				
Both parents	67.5	71.1	-	-
Single parent	21.5	16.6	-	-
Step-family	9.1	10.6	-	-
Other	1.9	1.6	-	-
Family affluence group (%)				
High	23.7	21.3	25.8	23.1
Medium	51.7	54.7	54.5	54.9
Low	24.7	24.0	19.7	22.0
Free school meal entitlement (%)	25.3	19.5	19.8	15.8
Ethnicity (%)				
White	96.8	97.7	-	-
Other	3.2	2.3	-	-

Chapter 14

Physical activity participation across the primary-secondary school transition

14.1 Introduction

This chapter presents findings on patterns of physical activity behaviour across the primary-secondary school transition. Data are based on a range of measures used in the PASS study including moderate-to-vigorous physical activity, vigorous physical activity frequency and duration, membership of sports clubs in and out of school, and the Physical Activity Questionnaire for Older Children (PAQ-C) short form. These measures are described in more detail in Chapter 10. The data show important socio-demographic patterning of physical activity by age, gender and socio-economic status, each of which is likely to act as a moderator variable among this age group. Patterning of physical activity behaviour by maturational status is also explored as puberty may be another important moderator of physical activity participation. The measures of pubertal development included in the PASS study were limited and therefore are not included in the regression modelling presented in later chapters. However, some preliminary analyses are presented here.

14.2 Gender differences in physical activity behaviours

Moderate-to-vigorous physical activity

The measure of moderate-to-vigorous physical activity (MVPA) included in the survey is used to classify pupils according to whether or not they met the current physical activity guidelines. Table 14.1 shows the proportion of pupils who take part in at least 60 minutes of MVPA on five or more days per week, based on their self-reported MVPA during the last seven days and a typical week. Proportions are low with only around a third of boys (34.6%) and a fifth of girls (20.0%) achieving this level of physical activity. Among boys, this proportion remains stable between P7 and S2, but among girls there is a small but significant decrease during this time period.

Vigorous physical activity

Two measures of pupils' participation in vigorous physical activity (VPA) during their leisure time were included in the study: frequency and duration. Table 14.1 shows the proportion of pupils who reported that they usually take part in VPA four or more times a week and two or more hours a week. Significant gender differences were found in both P7 and S2, with boys more likely to be vigorously active than girls. Frequency of participation in VPA remained stable among boys between P7 and S2 but decreased significantly among girls during this transition phase. Conversely, the proportion of pupils spending two or more hours a week in vigorous physical activity increased significantly among both boys and girls. The fact that duration of vigorous physical activity increased while frequency of participation decreased seems at first to be contradictory. However, this finding has been reported elsewhere (Wold, 1989) and suggests that, while young people moving from childhood to adolescence may take part in structured or vigorous activities less often in their free time, the amount of time spent in vigorous activity per 'episode' may actually increase.

Participation in sports clubs at school and outside of school

Table 14.1 shows reported membership of sports clubs at school for boys and girls in P7 and S2. There was no gender difference in participation in P7 with approximately half of boys (52.0%) and girls (49.9%) reporting that they were members of a sports club at school. However, a significant gender difference is evident in S2 with boys more likely than girls to be members of a sports club at secondary school. A significant decrease in school sports club membership occurs between P7 and S2 for both boys and girls, but this decrease is more marked among girls. In S2, one in three boys (33.7%) but less than one in five girls (17.9%) were members of a sports club at school.

Unlike participation in sports clubs at school, there was a significant gender difference in membership of sports clubs *outside* of school in P7 as well as in S2, with boys reporting higher levels of participation than girls in both years. In P7, almost three-fifths (58.9%) of boys were members of a community sports club compared with just over two-fifths (44.8%) of girls. Membership in S2 was 50.3% and 32.7% respectively showing a significant decrease over time among both genders. The data indicate that, in the early secondary school years, more pupils are involved in sports clubs outside of school than at school. This may be a reflection of the type and / or number of extra-curricular activities on offer with perhaps a more limited range of opportunities available within the school setting.

Physical Activity Questionnaire for Older Children (PAQ-C)

As previously described in Chapter 10, the short-form PAQ-C score gives a measure of young people's overall participation in physical activity during their leisure time. As expected, there was a significant gender difference in mean PAQ-C score in both P7 and S2 and the mean difference increased over time (Figure 14.1). In P7, boys had a mean score of 3.11 compared with 2.82 among girls. This represents a mean difference of 0.29 (95% CI: 0.19-0.39). In S2, boys had a mean score of 3.04 compared with 2.52 among girls, representing a mean difference of 0.52 (95% CI: 0.43-0.62). While there was no significant change in PAQ-C score among boys between P7 and S2, a significant decrease was observed among girls indicating that girls become less physically active in their free time as they get older (Table 14.1).

Table 14.1: Physical activity participation by year and gender

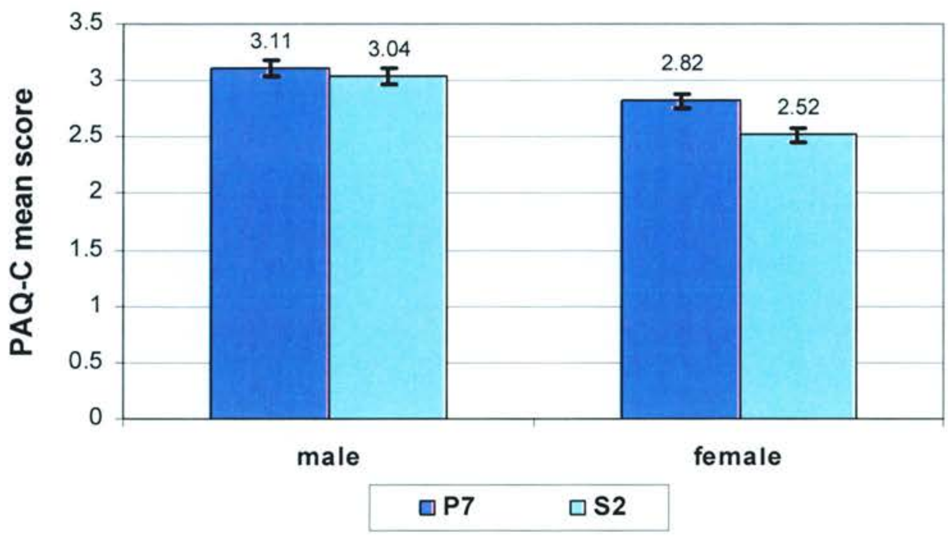
	% pupils		
	P7	**S2**	***P7-S2 change*** [$]
MVPA 5+ days per week			
Boys	34.6	33.2	*ns*
Girls	20.0	15.7	*decrease**
gender difference [#]	*p<0.001*	*p<0.001*	
Vigorous activity 4+ times a week			
Boys	58.8	60.6	*ns*
Girls	45.0	34.9	*decrease****
gender difference [#]	*p<0.001*	*p<0.001*	
Vigorous activity 2+ hours a week			
Boys	60.1	73.9	*increase****
Girls	47.5	54.1	*increase****
gender difference [#]	*p<0.001*	*p<0.001*	
Member of school sports club			
Boys	52.0	33.7	*decrease****
Girls	49.9	17.9	*decrease****
gender difference [#]	*ns*	*p<0.001*	
Member of community sports club			
Boys	58.9	50.3	*decrease***
Girls	44.8	32.7	*decrease****
gender difference [#]	*p<0.001*	*p<0.001*	
	Mean (sd)		
PAQ-C score			
Boys	3.11 (0.81)	3.04 (0.81)	*no change*
Girls	2.82 (0.78)	2.52 (0.75)	*decrease****
gender difference [#]	*p<0.001*	*p<0.001*	

[#] For categorical variables, gender differences assessed using Chi-squared test. For PAQ-C mean score, gender difference assessed using independent samples t-test

[$] For categorical variables, P7-S2 change assessed using Chi-squared test for trend analysis. For PAQ-C mean score, P7-S2 change assessed using paired samples t-test. P values calculated for those with valid data in both years only.

* p<0.05, ** p<0.01, *** p<0.001, ns=not significant

Figure 14.1 Mean PAQ-C score by year and gender



14.3 Socio-economic status and physical activity

The relationship between physical activity and socio-economic status, as measured by the Family Affluence Scale (FAS), is shown in Table 14.2 for both genders combined. In P7, VPA duration, membership of community sports clubs and PAQ-C mean score showed significant differences by family affluence group; those from high affluence families reported more time spent in vigorous activity, were more likely to be members of a sports club outside of school and had a higher PAQ-C mean score than their less affluent peers. By S2, however, differences by FAS group were also significant for VPA frequency, taking part in at least 60 minutes of MVPA on five or more days a week and membership of school sports clubs with high affluence pupils reporting higher levels of physical activity across all measures. The table also shows changes in physical activity between P7 and S2 by family affluence group. Reported time spent in vigorous physical activity increased across all three FAS groups, while membership of sports clubs at school and PAQ-C mean score decreased among all groups. However, differential changes in physical activity participation were found for VPA frequency, MVPA participation and membership of sports clubs outside of school. For these three outcomes, physical activity participation declined only among children from lower affluence families.

Table 14.2: Physical activity participation by family affluence

	% pupils		
	P7	**S2**	***P7-S2 change***[$]
MVPA 5+ days per week			
High FAS	29.4	29.7	*ns*
Medium FAS	26.4	23.8	*ns*
Low FAS	26.4	18.4	*decrease**
FAS group difference[#]	*ns*	*p<0.05*	
Vigorous activity 4+ times a week			
High FAS	57.3	55.8	*ns*
Medium FAS	51.5	46.8	*ns*
Low FAS	46.7	38.5	*decrease**
FAS group difference[#]	*ns*	*p<0.01*	
Vigorous activity 2+ hours a week			
High FAS	68.5	75.8	*increase**
Medium FAS	52.2	62.2	*increase****
Low FAS	43.4	56.3	*increase***
FAS group difference[#]	*p<0.001*	*p<0.001*	
Member of school sports club			
High FAS	54.0	32.0	*decrease****
Medium FAS	52.6	24.3	*decrease****
Low FAS	45.9	21.3	*decrease****
FAS group difference[#]	*ns*	*p<0.05*	
Member of community sports club			
High FAS	62.9	55.8	*ns*
Medium FAS	52.9	38.5	*decrease****
Low FAS	40.5	31.5	*decrease**
FAS group difference[#]	*p<0.001*	*p<0.001*	
PAQ-C score	**Mean (sd)**		
High FAS	3.12 (0.77)	2.95 (0.75)	*decrease****
Medium FAS	2.94 (0.80)	2.70 (0.81)	*decrease****
Low FAS	2.82 (0.81)	2.71 (0.87)	*decrease***
FAS group difference[#]	*p<0.001*	*p<0.001*	

[#] For categorical variables, FAS group differences assessed using Chi-squared test. For PAQ-C mean score, FAS group differences assessed using analysis of variance.
[$] For categorical variables, P7-S2 change assessed using Chi-squared test for trend analysis. For PAQ-C mean score, P7-S2 change assessed using paired samples t-test. P values calculated for those with valid data in both years only.
* p<0.05, ** p<0.01, *** p<0.001, ns=not significant

These results provide evidence that physical activity behaviour varies according to a child's material wealth with children from high affluence families reporting highest levels of participation. It also appears that these socio-economic inequalities in physical activity emerge or increase with age among the early adolescent population. The relationship between family affluence and physical activity is explored further in Chapter 16 as part of the model of social influences on physical activity behaviour.

14.4 Puberty and physical activity

Recent research suggests that pubertal development may influence physical activity behaviour during early adolescence. As described in Chapter 11, a small number of maturational indices were included in the PASS study. These are not considered robust enough for inclusion in the later regression models. However, based on these measures, the evidence for possible associations between puberty and physical activity are shown below, separately for boys and girls.

Relative physical development

A single item was used to measure perceived stage of physical development relative to one's peers. The five original response categories were combined into three groups: early, on-time, or late (Table 14.3). Over a quarter of boys and a fifth of girls classified themselves as early developers relative to their peers in both P7 and S2. Agreement between perceptions of relative physical development in P7 and S2 among boys just reached statistical significance but was very low (kappa=0.07, p=0.05), which perhaps reflects the difficulty for boys of identifying external markers of maturation, particularly at age 11 years. Among girls, however, there was low but significant agreement between subjective ratings of developmental status at the two time points (kappa=0.22, $p<0.001$). Almost half of girls who classified themselves as 'early' and almost three-quarters of those who classified themselves as 'on-time' in P7 also did so in S2.

Table 14.3: Perceived relative physical development by year and gender

	P7 (%)		S2 (%)	
	boys	**girls**	**boys**	**girls**
	(n=523)	*(n=552)*	*(n=513)*	*(n=554)*
Early	26.6	19.2	26.9	20.2
About the same	62.3	67.0	64.7	65.0
Late	11.1	13.8	8.4	14.8
*gender difference**	*$p<0.05$*		*$p<0.01$*	

** gender difference calculated using chi-squared test*

Table 14.4 shows the relationship between self-reported stage of maturation relative to one's peers and a range of physical activity outcomes for boys. In P7, there were significant differences in levels of physical activity participation by relative physical development, with early maturing boys reporting higher levels of physical activity on all six measures. For example, almost half of early developers (46.7%), but only around a quarter of late developers (26.9%), took part in at least 60 minutes of MVPA on five or more days a week. By S2, these differences disappeared for vigorous physical activity participation and PAQ-C mean score but early developers were still more likely at this age to take part in MVPA and be members of a sports club in and out of school. The data suggest that late maturing boys may be at particular risk of low physical activity during this transitional period. Changes in physical activity between P7 and S2 are also shown by maturational group. Among all three groups, there were no significant changes over time in MVPA participation or VPA frequency. Duration of VPA increased among the on-time and late developers only. Membership of school sports clubs decreased among all three groups, but membership of community sports clubs decreased among early and later developers only. By S2, only a quarter of late developing boys were members of a sports club at school or in the community.

Analysis of variance was undertaken to compare mean PAQ-C scores by relative physical development group among boys. A significant association was found in P7

($p<0.001$) but not in S2. P7 boys who reported that they were early developers relative to their peers were more active than both on-time and late developers. Post-hoc tests revealed no difference between the on-time and late developing groups. Associations between relative physical development and physical activity among boys were further explored using linear regression analyses. P7 boys' perceptions of their own physical development were found to explain 4.9% of the total variance in PAQ-C score. These findings indicate that early maturation is physically advantageous to boys and probably reflects the fact that as boys enter puberty they become taller and more muscular – both attributes which would be beneficial to most types of physical activity. However, between P7 and S2, PAQ-C mean score decreased among early developing boys, but not among the other two groups.

Table 14.5 shows the relationship between self-reported stage of maturation relative to one's peers and a range of physical activity outcomes for girls. In P7, there was no significant association between perceived relative physical development and physical activity for the majority of outcome measures. The one exception was membership of community sports clubs which was higher among early and on-time developers compared with those who rated their physical development as late relative to their peers. Associations changed with age such that, in S2, the difference in community sports club membership was not significant, but late developers reported lower VPA frequency and higher membership of school sports clubs. The fact that these results appear to conflict with each other and that the effects are relatively small suggests that perceived relative physical development may not be a robust indicator of maturational status in girls.

Changes in physical activity between P7 and S2 are also shown by maturational group. The proportion of girls taking part in at least 60 minutes of MVPA on five or more days per week did not change over time for any of the three groups. Frequency of VPA decreased and duration increased among the on-time and late developers only. Membership of sports clubs in school decreased among all groups while membership of sports clubs outside of school declined among early and on-time developers only. PAQ-C mean score also decreased among early and on-time developers but there was no significant change among late developers. The absence of clear patterning by perceived maturational status would support the notion that this measure, as a stand alone item, may be inadequate for discriminating between stages of pubertal development among girls.

Menarche

Among girls, two additional measures of pubertal status were included; menarcheal status and menarcheal timing. In P7, around one in ten girls (9.5%) had begun menstruating but this increased to almost two-thirds (63.5%) by S2. In each year, those who had begun menstruating were categorised as *post-menarcheal* and those who had not yet begun were categorised as *pre-menarcheal*. Table 13.6 shows the association between menarcheal status and physical activity. In P7 and S2, there was a small but significant difference ($p<0.05$) for MVPA participation, with post-menarcheal girls more likely to take part in MVPA on a regular basis than pre-menarcheal girls. No other differences were evident in P7, but in S2, pre-menarcheal girls were more likely to be members of a school or community sports club.

Changes in physical activity between P7 and S2 are also shown by menarcheal status. The proportion of girls taking part in at least 60 minutes of MVPA on five or more days per week and who were members of a sports club at school decreased among both groups. Among post-menarcheal girls, membership of community sports clubs also decreased, but there was no change in frequency or duration of VPA or in PAQ-C mean score. Among pre-menarcheal girls, VPA frequency and PAQ-C mean score decreased, but VPA duration increased.

In relation to menarcheal timing, those girls who had begun menstruating by P7 were categorised as 'early' developers (9.5%) and those who had not yet begun were categorised as 'on-time' (90.5%). By S2, 22.2% of girls were categorised as 'early' developers and 77.8% were 'on-time' relative to their peers. A small but significant difference ($p<0.05$) in MVPA was found among P7 girls, with 30.2% of 'early' developers taking part in MVPA on a regular basis compared with 18.9% of 'on-time' developers. However, this effect disappeared by S2 and no other significant associations were found between menarcheal timing and physical activity.

14.5 Summary of key findings

- Boys reported higher levels of participation on all measures of physical activity with the exception of membership of school sports clubs in P7.
- Age-related declines were apparent across a range of physical activity outcomes. These were more marked among girls than boys.
- Decreases in physical activity between P7 and S2 were most evident among children from low affluent families.
- Maturational status was found to be associated with physical activity among boys. Early maturation relative to one's peers appears to be an advantage in relation to boys' levels of physical activity. There was no consistent association among girls.

Table 14.4: Physical activity participation by relative physical development among BOYS

	% pupils		
	P7	**S2**	***P7-S2 change*[$]**
MVPA 5+ days per week			
Early	46.7	40.0	*ns*
On-time	30.3	32.5	*ns*
Late	26.9	19.0	*ns*
Maturational group difference[#]	*p<0.01*	*p<0.05*	
Vigorous activity 4+ times a week			
Early	72.5	64.2	*ns*
On-time	56.1	59.7	*ns*
Late	40.4	58.1	*ns*
Maturational group difference[#]	*p<0.001*	*ns*	
Vigorous activity 2+ hours a week			
Early	67.4	74.3	*ns*
On-time	60.5	74.6	*increase****
Late	42.1	65.1	*increase**
Maturational group difference[#]	*p<0.01*	*ns*	
Member of school sports club			
Early	62.8	43.5	*decrease***
On-time	46.7	30.6	*decrease****
Late	57.9	25.6	*decrease***
Maturational group difference[#]	*p<0.01*	*p<0.05*	
Member of community sports club			
Early	71.3	56.9	*decrease***
On-time	55.2	51.1	*ns*
Late	49.1	25.6	*decrease**
Maturational group difference[#]	*p<0.01*	*p<0.01*	
PAQ-C score	**Mean (sd)**		
Early	3.39 (0.79)	3.13 (0.81)	*decrease***
On-time	3.04 (0.77)	3.04 (0.78)	*ns*
Late	2.80 (0.90)	2.82 (0.86)	*ns*
Maturational group difference[#]	*p<0.001*	*ns*	

[#] For categorical variables, maturational group differences assessed using Chi-squared test. For PAQ-C mean score, maturational group differences assessed using analysis of variance.
[$] For categorical variables, P7-S2 change assessed using Chi-squared test for trend analysis. For PAQ-C mean score, P7-S2 change assessed using paired samples t-test. P values calculated for those with valid data in both years only, therefore percentages compared in change analysis may differ from those presented in the table.
* p<0.05, ** p<0.01, *** p<0.001, ns=not significant

Table 14.5: Physical activity participation and relative physical development among GIRLS

	% pupils		
	P7	**S2**	***P7-S2 change***[$]
MVPA 5+ days per week			
Early	23.6	20.5	*ns*
On-time	20.2	15.6	*ns*
Late	16.4	8.6	*ns*
Maturational group difference[#]	*ns*	*ns*	
Vigorous activity 4+ times a week			
Early	51.0	43.2	*ns*
On-time	44.1	35.0	*decrease***
Late	42.7	24.4	*decrease**
Maturational group difference[#]	*ns*	*p<0.05*	
Vigorous activity 2+ hours a week			
Early	51.4	47.3	*ns*
On-time	49.2	56.0	*increase**
Late	36.0	58.5	*increase***
Maturational group difference[#]	*ns*	*ns*	
Member of school sports club			
Early	46.7	18.0	*decrease****
On-time	51.2	16.2	*decrease****
Late	50.7	28.4	*decrease***
Maturational group difference[#]	*ns*	*p<0.05*	
Member of community sports club			
Early	50.0	27.0	*decrease****
On-time	47.0	33.6	*decrease****
Late	30.7	40.2	*ns*
Maturational group difference[#]	*p<0.05*	*ns*	
PAQ-C score	**Mean (sd)**		
Early	2.95 (0.79)	2.45 (0.78)	*decrease****
On-time	2.81 (0.77)	2.54 (0.74)	*decrease****
Late	2.80 (0.78)	2.56 (0.71)	*ns*
Maturational group difference[#]	*ns*	*ns*	

[#] For categorical variables, maturational group differences assessed using Chi-squared test. For PAQ-C mean score, maturational group differences assessed using analysis of variance.
[$] For categorical variables, P7-S2 change assessed using Chi-squared test for trend analysis. For PAQ-C mean score, P7-S2 change assessed using paired samples t-test. P values calculated for those with valid data in both years only, therefore percentages compared in change analysis may differ from those presented in the table.
* p<0.05, ** p<0.01, *** p<0.001, ns=not significant

Table 14.6: Physical activity participation by menarcheal status among GIRLS

	% pupils		
	P7	**S2**	***P7-S2 change[$]***
MVPA 5+ days per week			
Pre-menarcheal	18.9	11.0	*decrease***
Post-menarcheal	30.2	18.2	*decrease**
Maturational group difference[#]	*p<0.05*	*p<0.05*	
Vigorous activity 4+ times a week			
Pre-menarcheal	45.4	30.1	*decrease****
Post-menarcheal	44.2	37.3	*ns*
Maturational group difference[#]	*ns*	*ns*	
Vigorous activity 2+ hours a week			
Pre-menarcheal	47.5	57.4	*increase**
Post-menarcheal	48.1	51.3	*ns*
Maturational group difference[#]	*ns*	*ns*	
Member of school sports club			
Pre-menarcheal	49.8	22.4	*decrease****
Post-menarcheal	50.0	14.6	*decrease****
Maturational group difference[#]	*ns*	*p<0.05*	
Member of community sports club			
Pre-menarcheal	44.9	38.3	*ns*
Post-menarcheal	45.3	28.6	*decrease**
Maturational group difference[#]	*ns*	*p<0.05*	
PAQ-C score	**Mean (sd)**		
Pre-menarcheal	2.91 (.82)	2.81 (.77)	*decrease****
Post-menarcheal	2.81 (.78)	2.80 (.80)	*ns*
Maturational group difference[#]	*ns*	*ns*	

[#] For categorical variables, maturational group differences assessed using Chi-squared test. For PAQ-C mean score, maturational group differences assessed using analysis of variance.
[$] For categorical variables, P7-S2 change assessed using Chi-squared test for trend analysis. For PAQ-C mean score, P7-S2 change assessed using paired samples t-test. P values calculated for those with valid data in both years only, therefore percentages compared in change analysis may differ from those presented in the table.
* p<0.05, ** p<0.01, *** p<0.001, ns=not significant

Chapter 15

Psychological model

15.1 Introduction

This chapter presents results from analyses of psychological factors and their relationship with physical activity. Nine explanatory variables measuring attitudes to physical activity and self-perceptions were included in the analyses: enjoyment, current intention, exercise self-efficacy, perceived sports competence, the perceived benefits/barriers differential, self-esteem, physical self worth, body image and body satisfaction. Changes in the explanatory variables occurring between P7 and S2 are also reported. For categorical variables, change over time was assessed using Chi-squared test for trend analysis. For continuous variables, change over time was assessed using Wilcoxon Signed Rank Test.

15.2 Enjoyment

Age and gender differences in enjoyment of physical activity are shown in Table 15.1. There was a significant gender difference in enjoyment in S2 ($p<0.001$) but not in P7. In P7, over two-thirds of girls and three-quarters of boys reported that they enjoy physical activity a lot. Between P7 and S2, there was a small but significant increase in enjoyment among boys ($p<0.05$) but a marked decrease among girls ($p<0.001$). In S2, only half of girls reported high enjoyment compared with four-fifths of boys.

The association between enjoyment and physical activity was assessed using an independent samples t-test (Table 15.2). Among both boys and girls, a significant positive association was found in P7 and S2; high enjoyment was associated with higher levels of physical activity. Associations between enjoyment and physical activity were further explored using linear regression analyses (Tables 15.3 and 15.4). Enjoyment of physical activity explained between 10% and 14% of the total variance in behaviour. The strongest effect was among S2 girls.

15.3 Current intention

Age and gender differences in intention to be physically active are shown in Table 15.1. There was a significant gender difference in both P7 ($p<0.05$) and S2 ($p<0.001$). In P7, 37.0% of boys and 30.2% of girls reported high intention. Between P7 and S2, the proportion of boys reporting high intention remained stable but there was a significant decrease among girls so that, by S2, just over a fifth of girls (22.3%) reported high intention.

The association between current intention and physical activity was assessed using an independent samples t-test (Table 15.2). A significant positive association was found among boys and girls in both P7 and S2; high intention was associated with higher levels of physical activity. The relationship between intention and physical activity was further explored using linear regression analyses (Tables 15.3 and 15.4). Intention to be active explained between 16% and 27% of the total variance in behaviour. The strongest effect was among S2 boys.

15.4 Exercise self-efficacy

Age and gender differences in exercise self-efficacy are shown in Table 15.1. There was no significant gender difference in P7 but, in S2, boys reported higher self-efficacy than girls ($p<0.001$). Between P7 and S2, mean self-efficacy score remained stable among boys but decreased among girls ($p<0.001$).

The association between self-efficacy and physical activity was assessed using Spearman's rank correlation. A significant moderate[j] correlation was found among boys and girls in both P7 and S2. Among boys, Spearman's rank correlation coefficient was 0.37 in P7 (n=457, p<0.001) and 0.42 in S2 (n=496, p<0.001). Among girls, the correlation coefficient was 0.36 in P7 (n=524, p<0.001) and 0.44 in S2 (n=549, p<0.001). The relationship between self-efficacy and physical activity was further explored using linear regression analyses (Tables 15.3 and 15.4). Exercise self-efficacy explained between 13% and 20% of the variance in behaviour. The strongest effect was among S2 pupils.

15.5 Perceived sports competence

Age and gender differences in perceived competence are shown in Table 15.1. There was a significant gender difference in both P7 (p<0.001) and S2 (p<0.001) with boys reporting higher perceived competence than girls. Between P7 and S2, perceived competence decreased among both boys and girls (p<0.001).

The association between perceived competence and physical activity was assessed using Spearman's rank correlation. A significant moderate correlation was found among boys and girls in both P7 and S2. Among boys, Spearman's rank correlation coefficient was 0.48 in P7 (n=450, p<0.001) and 0.43 in S2 (n=495, p<0.001). Among girls, the correlation coefficient was 0.41 in P7 (n=512, p<0.001) and 0.38 in S2 (n=548, p<0.001). Associations between perceived competence and physical activity were further explored using linear regression analyses (Tables 15.3 and 15.4). Perceived competence explained between 15% and 24% of the variance in behaviour. The strongest effect was among P7 boys.

[j] As a guide to interpreting the strength of association between variables, Cohen (1988) defines the values of correlation coefficients as follows: 0.1 = small correlation, 0.3 = moderate correlation, ≥0.5 = large correlation.

15.6 Benefits-barriers differential

Age and gender differences in the perceived benefits-barriers differential are shown in Table 15.1. There was a significant gender difference in both P7 ($p<0.01$) and S2 ($p<0.001$) with boys reporting higher mean scores than girls. This means that boys were more likely than girls to perceive greater benefits of physical activity relative to perceived barriers. Between P7 and S2, perceived benefits and perceived barriers both remained stable among boys. Among girls, however, there was a significant decrease in perceived benefits and a corresponding increase in perceived barriers ($p<0.001$).

Responses to the individual perceived benefits and perceived barriers items are shown in Appendix 7. Overall, the most common perceived benefits were being healthy, keeping in shape and having fun. In S2, feeling better about oneself and getting stronger were also commonly cited as reasons for doing physical activity. The most common barriers among P7 pupils were poor weather, lack of equipment and lack of access to places to do physical activity. In S2, poor weather, lack of equipment and having too much homework were the most common barriers. Among S2 girls, one third cited feeling embarrassed and two-fifths cited lack of skill as reasons for not being active.

The association between the perceived benefits-barriers differential mean score and physical activity was assessed using Spearman's rank correlation. A significant moderate correlation was found among boys and girls in both P7 and S2. Among boys, Spearman's rank correlation coefficient was 0.40 in P7 ($n=423$, $p<0.001$) and 0.46 in S2 ($n=492$, $p<0.001$). Among girls, the correlation coefficient was 0.44 in P7 ($n=492$, $p<0.001$) and 0.39 in S2 ($n=548$, $p<0.001$). Associations with physical activity were further explored using linear regression analyses (Tables 15.3 and 15.4). The benefits-barriers differential explained between 16% and 22% of the variance in behaviour. The strongest effects were among P7 girls and S2 boys.

15.7 Body image

Age and gender differences in perceived body image by gender and year are shown in Table 15.1. There was a significant gender difference in S2 but not in P7. S2 girls were less likely to have a positive body image and more likely to consider themselves overweight than their male peers; almost two-fifths (39.1%) of girls said that they were too fat compared with just over a quarter (27.5%) of boys. Between P7 and S2, there was a significant increase in the proportion of girls reporting that they were too fat ($p<0.001$) but no significant change among boys.

Analysis of variance was undertaken to compare mean PAQ-C score by body image group among boys and girls (Table 15.2). Among boys, there was a significant relationship between body image and physical activity in both P7 ($p<0.01$) and S2 ($p<0.001$). Post-hoc tests revealed that those boys who thought they were too fat were significantly less active compared with those who said they were about right or too thin. There was no difference between these latter two groups. Among girls, no association between body image and physical activity was found in either P7 or S2. Therefore body image was excluded from subsequent analyses for girls.

Among boys, associations between body image and physical activity were further explored using linear regression analyses (Table 15.3). Body image (perceiving oneself as too fat) explained around 3% of the total variance in behaviour in both P7 and S2 boys.

15.8 Body satisfaction

Table 15.1 shows pupils' satisfaction with their current body shape by gender and year. There was a significant gender difference in S2 but not in P7. Compared with their male peers, S2 girls were less likely to be happy with their body shape and more likely to report that they would like to be thinner. The data show high levels of body dissatisfaction among both boys and girls; only around two-fifths of boys and just over a third of girls were happy with their body shape in both P7 and S2. In both years, over half of girls reported that they would like to be thinner. There was no significant change over time in body satisfaction among either boys or girls.

Analysis of variance was undertaken to compare mean PAQ-C score by body satisfaction group (Table 15.2). Among boys, a significant association between body satisfaction and physical activity was found in both P7 ($p<0.001$) and S2 ($p<0.01$). Post-hoc tests revealed that the significant difference was between the 'like to be thinner' and 'happy with body size' groups: boys who reported that they would like to be thinner were significantly less active than those who were satisfied with their body size. Among girls, there was no significant association between body satisfaction and physical activity in either P7 or S2. Therefore body satisfaction was excluded from further analyses for girls.

The relationship between body satisfaction and physical activity in boys was further explored using linear regression analyses (Table 15.3). Body satisfaction (like to be thinner) explained 5% of the variance in PAQ-C score among P7 boys and 2% among S2 boys.

15.9 Physical self worth

Age and gender differences in physical self worth are shown in Table 15.1. There was a significant gender difference in both P7 and S2 with boys reporting higher physical self worth than girls. Between P7 and S2, there was a significant decrease in reported physical self worth among girls ($p<0.001$) but no change among boys.

Associations between physical self worth and physical activity were assessed using Spearman's rank correlation. Correlations were low to moderate but significant for girls and boys in both P7 and S2. Among boys, Spearman's rank correlation coefficient was 0.32 in P7 ($n=455$, $p<0.001$) and 0.27 in S2 ($n=483$, $p<0.001$). Among girls, the correlation coefficient was 0.22 in P7 ($n=517$, $p<0.001$) and 0.24 in S2 ($n=545$, $p<0.001$). The relationship between physical self worth and physical activity was further explored using linear regression analyses (Tables 15.3 and 15.4).

Physical self worth explained between 5% and 10% of the total variance in behaviour. The strongest effect was among P7 boys.

15.10 Self-esteem

Age and gender differences in global self-esteem are shown in Table 15.1. There was a significant gender difference in both P7 and S2 with boys reporting higher self-esteem than girls. Between P7 and S2, there was a significant decrease in reported self-esteem among girls ($p<0.001$) but no change among boys.

Associations between self-esteem and physical activity were assessed using Spearman's rank correlation. Correlations were low but significant for girls and boys in both P7 and S2. Among boys, Spearman's rank correlation coefficient was 0.25 in P7 ($n=423$, $p<0.001$) and 0.19 in S2 ($n=481$, $p<0.001$). Among girls, the correlation coefficient was 0.15 in P7 ($n=481$, $p<0.01$) and 0.12 in S2 ($n=541$, $p<0.01$).

Physical self worth and self-esteem were found to be highly correlated with each other. Among boys, Spearman's rank correlation coefficient was 0.70 in P7 and 0.68 in S2. Among girls, it was 0.73 in P7 and 0.74 in S2. Therefore it was not appropriate to include both variables in the same model due to the problems associated with multicollinearity. Theory suggests that physical activity behaviour may be more strongly influenced by self-perceptions in the physical domain than by more global measures of self-esteem. Indeed, higher correlation coefficients were found for physical self-worth than for self-esteem. Therefore it was decided to keep physical self worth in the model and exclude self-esteem from further analyses.

Table 15.1: Psychological variables descriptives and gender differences

	P7		S2	
	BOYS	**GIRLS**	**BOYS**	**GIRLS**
Enjoyment (%)	*(n=528)*	*(n=570)*	*(n=528)*	*(n=569)*
High	74.6	70.7	79.9	49.0
Low	25.4	29.3	20.1	51.0
gender difference#	*ns*		*p<0.001*	
Current intention (%)	*(n=524)*	*(n=567)*	*(n=526)*	*(n=570)*
High	37.0	30.2	41.3	22.3
Low	63.0	69.8	58.7	77.7
gender difference#	*p<0.05*		*p<0.001*	
Body image (%)	*(n=520)*	*(n=565)*	*(n=520)*	*(n=563)*
Too thin	15.2	12.9	14.6	8.3
About right	61.5	59.6	57.9	52.6
Too fat	23.3	27.4	27.5	39.1
gender difference#	*ns*		*p<0.001*	
Body satisfaction (%)	*(n=495)*	*(n=545)*	*(n=493)*	*(n=551)*
Happy with body shape	42.2	36.9	43.6	35.4
Like to be thinner	44.2	51.4	39.6	55.4
Like to be bigger	13.5	11.7	16.8	9.3
gender difference#	*ns*		*p<0.001*	
Self-efficacy	*(n=524)*	*(n=565)*	*(n=527)*	*(n=568)*
Mean (SD)	3.00 (.56)	2.94 (.59)	3.06 (.55)	2.82 (.63)
gender difference$	*ns*		*p<0.001*	
Perceived competence	*(n=517)*	*(n=554)*	*(n=526)*	*(n=568)*
Mean (SD)	3.37 (.51)	3.01 (.58)	3.26 (.58)	2.73 (.65)
gender difference$	*p<0.001*		*p<0.001*	
Benefits-barriers differential	*(n=483)*	*(n=532)*	*(n=523)*	*(n=567)*
Mean (SD)	1.55 (.87)	1.39 (.87)	1.50 (.97)	1.01 (.98)
gender difference$	*p<0.01*		*p<0.001*	
Self-esteem	*(n=488)*	*(n=519)*	*(n=511)*	*(n=559)*
Mean (SD)	3.16 (0.49)	3.01 (0.58)	3.19 (0.55)	2.80 (0.64)
gender difference$	*p<0.001*		*p<0.001*	
Physical self worth	*(n=525)*	*(n=559)*	*(n=514)*	*(n=565)*
Mean (SD)	3.22 (0.58)	3.01 (0.66)	3.26 (0.62)	2.74 (0.71)
gender difference$	*p<0.001*		*p<0.001*	

 # gender difference assessed by Chi-squared test
$ gender difference assessed by Mann-Whitney U test

Table 15.2: Associations between psychological categorical variables and physical activity

	n	P7 Mean PAQ-C score (SD)	*n*	S2 Mean PAQ-C score (SD)
BOYS				
Enjoyment				
High	*342*	3.28 (.77)	*396*	3.18 (.75)
Low	*115*	2.63 (.74)	*101*	2.51 (.77)
mean diff (95%CI)#		*-0.65 (-0.81, -0.49)****		*-0.67 (-0.84, -0.51)****
Current intention				
High	*171*	3.58 (.73)	*209*	3.54 (.67)
Low	*284*	2.84 (.74)	*287*	2.69 (.70)
mean diff (95%CI)#		*-0.72 (-0.86, -0.58)****		*-0.85 (-0.97, -0.72)****
Body image				
Too thin	*68*	3.12 (0.85)	*72*	2.96 (0.91)
About right	*279*	3.21 (0.80)	*287*	3.16 (0.78)
Too fat	*102*	2.85 (0.78)	*129*	2.81 (0.73)
between group diff$		*p<0.01*		*p<0.001*
Body satisfaction				
Happy with body shape	*191*	3.32 (0.75)	*203*	3.16 (0.82)
Like to be thinner	*186*	2.93 (0.81)	*180*	2.90 (0.73)
Like to be bigger	*57*	3.09 (0.90)	*79*	3.05 (0.82)
between group diff$		*p<0.001*		*p<0.01*
GIRLS				
Enjoyment				
High	*373*	2.98 (.77)	*271*	2.81 (.70)
Low	*152*	2.43 (.68)	*279*	2.24 (.69)
mean diff (95%CI)#		*-0.55 (-0.68, -0.41)****		*-0.57 (-0.69, -0.45)****
Current intention				
High	*159*	3.30 (.71)	*124*	3.12 (.73)
Low	*365*	2.61 (.72)	*426*	2.35 (.66)
mean diff (95%CI)#		*-0.69 (-0.82, -0.56)****		*-0.77 (-0.91, -0.63)****
Body image				
Too thin	*68*	2.78 (0.83)	*46*	2.35 (0.67)
About right	*306*	2.85 (0.79)	*282*	2.57 (0.78)
Too fat	*146*	2.78 (0.74)	*215*	2.50 (0.74)
between group diff$		*ns*		*ns*
Body satisfaction				
Happy with body shape	*182*	2.87 (0.79)	*185*	2.60 (0.78)
Like to be thinner	*259*	2.80 (0.79)	*296*	2.50 (0.71)
Like to be bigger	*64*	2.71 (0.74)	*50*	2.50 (0.76)
between group diff$		*ns*		*ns*

 # mean differences assessed by independent samples t-test
$ between group differences assessed by one-way anova
** p<0.05, ** p<0.01, *** p<0.001, ns=not significant*

Table 15.3: Associations between psychological variables and physical activity: results from linear regression analyses among BOYS

	n	β (95% CI)	B	F	$R^{2\ adj}$
P7					
Perceived competence	450	.775 (.646, .905)***	.485	138.08***	0.236
Intention (high)	455	.720 (.580, .860)***	.430	102.53***	0.185
Benefits-barriers differential	423	.383 (.303, .464)***	.414	87.01***	0.171
Self-efficacy	457	.522 (.400, .643)***	.367	70.72***	0.135
Enjoyment (high)	457	.652 (.491, .814)***	.349	63.30***	0.122
Physical self worth	455	.316 (.321, .568)***	.445	50.14***	0.098
Body satisfaction	434			11.44***	0.046
Happy with body shape (ref)		0	0		
Like to be thinner		-.238 (-.553, -.231)***	-.392		
Like to be bigger		-.092 (-.459, .013)	-.223		
Body image	449			7.38***	0.028
About right (ref)		0	0		
Too fat		-.184 (-.534, -.174)***	-.356		
Too thin		-.037 (-.298, .128)	-.085		
S2					
Intention (high)	496	.848 (.725, .971)***	.520	183.33***	0.271
Benefits-barriers differential	492	.388 (.322, .453)***	.466	135.66***	0.217
Self-efficacy	496	.650 (.534, .765)***	.446	122.53***	0.199
Perceived competence	495	.589 (.477, .700)***	.424	107.77***	0.179
Enjoyment (high)	497	.674 (.508, .840)***	.337	63.54***	0.114
Physical self worth	483	.282 (.260, .488)***	.374	41.62***	0.078
Body image	488			9.54***	0.034
About right (ref)		0	0		
Too fat		-.197 (-.520, -.193)***	-.356		
Too thin		-.088 (-.402, .004)	-.199		
Body satisfaction	462			5.19**	0.018
Happy with body shape (ref)		0	0		
Like to be thinner		-.159 (-.418, -.101)**	-.259		
Like to be bigger		-.048 (-.307, .104)	-.101		

* *$p<0.05$* ** *$p<0.01$* *** *$p<0.001$*

β = unstandardised coefficient, B = standardised coefficient

Table 15.4: Associations between psychological variables and physical activity: results from linear regression analyses among GIRLS

	n	β (95% CI)	B	F	$R^{2\,adj}$
P7					
Benefits-barriers differential	492	.412 (.341, .484)***	.455	127.79***	0.207
Perceived competence	512	.550 (.442, .657)***	.408	101.59***	0.166
Intention (high)	524	.690 (.556, .824)***	.405	102.29***	0.164
Self-efficacy	524	.478 (.371, .585)***	.359	77.23***	0.129
Enjoyment (high)	525	.547 (.406, .688)***	.317	58.45***	0.101
Physical self worth	517	.231 (.173, .370)***	.271	29.10***	0.052
S2					
Self-efficacy	549	.537 (.447, .626)***	.450	138.64***	0.202
Intention (high)	550	.771 (.635, .907)***	.430	124.09***	0.185
Benefits-barriers differential	548	.299 (.241, .358)***	.394	100.42***	0.155
Perceived competence	548	.449 (.358, .539)***	.385	95.21***	0.148
Enjoyment (high)	550	.569 (.453, .685)***	.380	92.25***	0.144
Physical self worth	545	.234 (.160, .332)***	.246	31.42***	0.053

* *$p<0.05$* ** *$p<0.01$* *** *$p<0.001$*

β = unstandardised coefficient, B = standardised coefficient

15.11 Multivariate analyses

Multiple regression analyses were undertaken with four separate models for P7 and S2 boys and P7 and S2 girls. Within each model, a staged process was undertaken using the 'enter' method and variables were entered into the model based on the R^2 value from linear regression analyses. Variables were entered into the model one at a time, with the variable with highest R^2 value entered first. Any variable which did not significantly improve the model was removed before the next variable was entered. Results are shown in Tables 15.5 to 15.8. Regression analyses were also undertaken to test for interaction effects between psychological variables. The variable with the strongest effect in each of the four models was tested for interactions with other variables in the models. Correlation matrices for the final models are shown in Appendix 6.

For P7 boys, all eight variables (excluding self-esteem) were entered into the model in the following order: perceived competence, intention, benefits-barriers differential, self-efficacy, enjoyment, physical self worth, body satisfaction and body image. Five variables remained in the model, accounting for 33.1% of the total variance. The analysis was re-run including interaction terms for perceived competence and all other variables in the model. No significant interaction effects were found. The final model is shown in Table 15.5.

For S2 boys, all eight variables were entered into the model in the following order: intention, benefits-barriers differential, self-efficacy, perceived competence, enjoyment, physical self worth, body image and body satisfaction. Only the first four variables remained in the model. The analysis was re-run including interaction terms for intention and all other variables in the model. None of the interaction terms made a significant contribution to the model. The final model explained 36.1% of total variance in PAQ-C score (Table 15.6).

For P7 girls, six variables were significantly associated with physical activity in linear regression analyses and were entered into the model in the following order: benefits-barriers differential, perceived competence, intention, self-efficacy, enjoyment and physical self worth. The addition of self-efficacy and physical self worth did not significantly improve the model and therefore these two variables were removed. The analysis was re-run including interaction terms for benefits-barriers differential and all other variables in the model. There was a significant interaction between perceived benefits-barriers differential and perceived competence. Therefore this variable was included in the final model. Further examination of the benefits-barriers x competence interaction suggested that, among girls who reported more barriers to physical activity than benefits, perceptions of competence made no difference to their overall levels of activity. In contrast, among girls reporting higher benefits than barriers, those with high perceived competence were more active than those with low perceived competence. Thus, among this particular group of children, relative perceptions of the benefits versus barriers to physical activity appear to moderate the relationship between perceived competence and physical activity. No other interaction effects were found. The final model explained 30.4% of the total variance in PAQ-C score (Table 15.7).

For S2 girls, six variables were significantly associated with physical activity and were entered into the model in the following order: self-efficacy, intention, benefits-barriers differential, perceived competence, enjoyment and physical self worth. Only self-efficacy, intention and enjoyment remained in the model. The analysis was re-run including interaction terms for self-efficacy x intention and self-efficacy x enjoyment. The interaction terms had no significant effect on the model and were therefore excluded. The final model explained 28.6% of the total variance in PAQ-C score (Table 15.8).

15.12 Summary of key findings

- Psychological factors showed significant age and gender differences. Among S2 pupils, boys reported more favourable scores than girls on all psychological indices.
- Psychological factors were strongly associated with physical activity among both boys and girls, accounting for between 29% and 33% of total variance in behaviour.
- The influence of psychological factors on physical activity varied by age and gender, specifically in relation to the relative importance of attitudes and physical self-perceptions.
- Among boys, perceived competence was the strongest influence in P7 and current intention was the strongest influence in S2.
- Among girls, the perceived benefits-barriers differential was the strongest influence in P7 and self-efficacy was the strongest influence in S2.
- Intention to be active was the most consistent correlate of physical activity.

Table 15.5: Multivariate model of psychological influences among P7 BOYS (n=415) showing unstandardised β coefficients (95% CI)

	Model 1	Model 2	Model 3	Model 4	Model 5
Perceived competence	.765 (.631, .899)***	.583 (.438, .729)***	.451 (.298, .605)***	.401 (.245, .556)***	.354 (.192, .515) ***
Current intention		.430 (.275, .585)***	.374 (.221, .528)***	.357 (.205, .510)***	.343 (.190, .495) ***
Benefits-barriers differential			.193 (.108, .278)***	.163 (.076, .250)***	.138 (.048, .228) **
Enjoyment				.258 (.089, .427)**	.240 (.071, .410) **
Self-efficacy					.146 (.007, .284) *
					Final model R^2*=0.340*
					Final model R^2 *adjusted = 0.331*

Dependent variable = PAQ-C score, * p<0.05, ** p<0.01, ***p<0.001

Table 15.6: Multivariate model of psychological influences among S2 BOYS (n=489) showing unstandardised β coefficients (95% CI)

	Model 1	Model 2	Model 3	Model 4
Current intention	.843 (.719, .968)***	.650 (.520, .779)***	.564 (.430, .697)***	.543 (.408, .678)***
Self-efficacy		.425 (.309, .541)***	.301 (.172, .429)***	.253 (.117, .389)***
Benefits-barriers differential			.159 (.084, .234)***	.133 (.053, .212)**
Perceived competence				.134 (.003, .265)*
				Final model R^2*=0.366*
				Final model R^2 *adjusted = 0.361*

Dependent variable = PAQ-C score, * p<0.05, ** p<0.01, ***p<0.001

Table 15.7: Multivariate model of psychological influences among P7 GIRLS (n=480) showing unstandardised β coefficients (95% CI)

	Model 1	Model 2	Model 3	Model 4	Model 5
Benefits-barriers differential	.415 (.343, .487)***	.309 (.226, .391)***	-.169 (-.492, .155)	-.142 (-.457, .172)	-.183 (-.499, .132)
Perceived competence		.300 (.177, .423)***	.104 (-.073, .281)	.076 (-.097, .249)	.034 (-.141, .210)
Benefits-barriers x perceived competence interaction term			.162 (.056, .268)**	.133 (.030, .237)*	.139 (.036, .243)**
Current intention				.380 (.239, .521)***	.363 (.221, .504)***
Enjoyment					.173 (.025, .321)*
					Final model R^2*=0.311*
					Final model R^2 *adjusted = 0.304*

Dependent variable = PAQ-C score, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 15.8: Multivariate model of psychological influences among S2 GIRLS (n=549) showing unstandardised β coefficients (95% CI)

	Model 1	Model 2	Model 3
Self-efficacy	.537 (.447, .626)***	.387 (.292, .482)***	.312 (.211, .413)***
Current intention		.519 (.376, .662)***	.461 (.317, .605)***
Enjoyment			.244 (.121, .367)***
			Final model R^2*=0.290*
			Final model R^2 *adjusted = 0.286*

Dependent variable = PAQ-C score, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Chapter 16

Social model

16.1 Introduction

This chapter presents the results from analyses of the relationship between social factors and physical activity. Seven social variables were included: family structure, family affluence, maternal support, paternal support, older sibling support, peer support and peer socialising. In the first part of the chapter, descriptive data and results from linear regression analyses are presented for each variable separately. Changes in the explanatory variables occurring between P7 and S2 are also reported. For categorical variables, change over time was assessed using Chi-squared test for trend analysis. For continuous variables, change over time was assessed using Wilcoxon Signed Rank Test. Results from multivariate analyses are presented in the second part of the chapter.

16.2 Family Structure

As discussed previously in Chapter 13, the majority of pupils (69.4%) said they lived with both their parents, 19.0% lived in a single parent household and 9.9% lived in a stepfamily. Analysis of variance was used to compare mean PAQ-C score by family type (Tables 16.2 and 16.3). No significant association was found between family structure and physical activity among either boys or girls. Thus family structure was excluded from further analyses.

16.3 Family affluence

Family affluence was used as an indicator of socio-economic status and measured using the Family Affluence Scale (FAS, Currie *et al.*, 1997; Boyce & Dallago, 2004). The distribution of boys and girls across FAS groups (low, medium, high) in P7 and S2 is shown in Table 16.1. There was no gender difference in family affluence in either year. Similarly, there was no significant change in family affluence between P7 and S2.

Analysis of variance was used to compare mean PAQ-C score by FAS group. A significant association was found between family affluence and physical activity for boys in P7 and for girls in both P7 and S2, with pupils from higher affluence families reporting higher levels of physical activity (Tables 16.2 and 16.3). There was no significant association among S2 boys and therefore family affluence was excluded from further analysis for this group. Post-hoc tests revealed that, among P7 boys and S2 girls, those in the high FAS group were significantly more active than those in the low or medium groups. Among P7 girls, those in the low FAS group were significantly less active than those in the medium and high FAS groups.

Dummy variables were created for family affluence so that its association with physical activity could be further explored using linear regression analyses (Tables 16.4-16.7). High family affluence was associated with higher levels of physical activity but accounted for less than 3% of overall variance in PAQ-C score.

16.4 Maternal support

Table 16.1 shows level of maternal support for being active, by year and gender. Over half of boys and girls reported high maternal support in both P7 and S2. In P7, girls were more likely than boys to report low maternal support, and more boys than girls reported that they do not have or do not see their mother ($p<0.05$). There was no significant gender difference in S2. Overall, less than one in five pupils said that they do not have or do not see their mother; these pupils were classified as having no maternal support. Reported levels of maternal support remained stable over time among both boys and girls.

Analysis of variance was used to compare mean PAQ-C score by level of maternal support in boys and girls (Tables 16.2 and 16.3, respectively). There was a significant association between maternal support and physical activity among boys and girls in both P7 and S2. Pupils who reported high levels of support from their mother were more likely to be active. Post-hoc tests revealed that, for both genders and in each year, those reporting high support were significantly different only from those reporting low support. The very small number of pupils who reported that they don't have or don't see their mother ('no mother' group) does not allow for meaningful analysis of these data.

Dummy variables were created for maternal support so that its association with physical activity could be further explored using linear regression analyses (Tables 16.4-16.7). High maternal support was associated with higher levels of physical activity and explained between 4-8% of the total variance in PAQ-C score. There was a stronger effect among girls than boys.

16.5 Paternal support

Table 16.1 shows level of paternal support by year and gender. Over half of boys and around two-fifths of girls reported high support for being active from their father in P7. Between P7 and S2, there was a significant increase in reported paternal support among both boys and girls ($p<0.05$) so that, over three-fifths of boys and almost half of girls reported high paternal support in S2. Boys reported higher levels of paternal support than girls in both P7 ($p<0.001$) and S2 ($p<0.001$). Overall, around one in ten pupils reported that they do not have or do not see their father; these pupils were classified as having no paternal support.

Analysis of variance was used to compare mean PAQ-C score by level of paternal support in boys and girls (Tables 16.2 and 16.3 respectively). There was a significant association between paternal support and physical activity among boys and girls in both P7 and S2. Pupils who reported high levels of support from their father were more likely to be active. Post-hoc tests revealed that, in P7, boys reporting high paternal support were significantly more active than those reporting low support but were no more active than those with no support. Among boys in S2 and girls in P7 and S2, those reporting high paternal support were significantly more active than those reporting low or no support. However, due to the small number of pupils who reported that they don't have or don't see their father ('no father' group), results for this group should be interpreted with caution.

Dummy variables were created for paternal support so that its association with physical activity could be further explored using linear regression analyses (Tables 16.4-16.7). High paternal support was associated with higher levels of physical activity and explained around 5% of the total variance in PAQ-C score among both boys and girls.

16.6 Older sibling support

Table 16.1 shows levels of support for being active from an older sibling, by year and gender. There was no significant gender difference in sibling support in either P7 or S2 and reported levels of support remained stable over time. Around a third of boys and girls reported high sibling support in P7 and S2. In each year, over a third of boys and around two fifths of girls said that they do not have or do not see their older sibling; these pupils were classified as having no sibling support.

Analysis of variance was used to compare mean PAQ-C score by level of sibling support in boys and girls (Tables 16.2 and 16.3 respectively). There was a significant association between older sibling support and physical activity among boys and girls in both P7 and S2. Pupils who reported high levels of sibling support were more likely to be active. Post-hoc tests revealed that boys reporting high levels of support from an older sibling were more active than those reporting low support in both P7 and S2, but were not significantly different from those with no support. Girls with high levels of sibling support were more active than those with low or no support.

Dummy variables were created for sibling support so that its association with physical activity could be further explored using linear regression analyses (Tables 16.4-16.7). High sibling support was associated with higher levels of physical activity but, for both boys and girls, this explained less than 4% of the total variance in PAQ-C score. There appeared to be a slightly stronger effect among girls than boys.

16.7 Peer support

Table 16.1 shows mean peer support score by year and gender. In both years, there was a significant gender difference, with boys reporting higher levels of peer support for being active than girls ($p<0.001$). Between P7 and S2, peer support decreased among both boys ($p<0.05$) and girls ($p<0.001$).

The association between peer support and physical activity was assessed using Spearman's rank correlation. Correlations were low to moderate but significant in both P7 and S2. Among boys, Spearman's rank correlation coefficient was 0.32 in P7 ($n=438$, $p<0.01$) and 0.33 in S2 ($n=463$, $p<0.01$). Among girls, the correlation coefficient was 0.21 in P7 ($n=513$, $p<0.01$) and 0.32 in S2 ($n=530$, $p<0.01$). Associations between peer support and physical activity were further explored using linear regression analyses. Results are shown in Tables 16.4-16.7. High levels of peer support were associated with higher levels of physical activity. Among boys in both year groups and girls in S2, this explained around 10% of the total variance in PAQ-C score. There was a weaker effect among P7 girls, accounting for only 4% of the variance.

16.8 Peer socialising

Table 16.1 shows mean peer socialising score (number of afternoons and evenings spent with friends on school days per week) by year and gender. In P7, time spent with friends was significantly higher among boys than girls ($p<0.01$), but no gender difference was found in S2. Between P7 and S2, peer socialising increased among both boys ($p<0.05$) and girls ($p<0.001$).

The association between peer socialising and physical activity was assessed using Spearman's rank correlation. Significant associations were found in both P7 and S2, with moderate correlations for boys and low correlations for girls. Among boys, Spearman's rank correlation coefficient was 0.40 in P7 ($n=436$, $p<0.01$) and 0.36 in S2 ($n=457$, $p<0.01$). Among girls, the correlation coefficient was 0.24 in P7 ($n=507$, $p<0.01$) and 0.11 in S2 ($n=526$, $p<0.05$). Associations between peer socialising and physical activity were further explored using linear regression analyses (Tables 16.4-16.7). High levels of peer socialising were associated with higher levels of physical activity, but this effect was much stronger among boys than girls. Peer socialising explained between 13-16% of the total variance in PAQ-C score among boys but less than 6% among girls. The weakest effect was among S2 girls.

Table 16.1: Social variables descriptives and gender differences				
	P7		**S2**	
	boys	**girls**	**boys**	**girls**
Family affluence (%)	*(n=511)*	*(n=554)*	*(n=488)*	*(n=546)*
Low	24.7	24.0	19.7	22.0
Medium	51.7	54.7	54.5	54.9
High	23.7	21.3	25.8	23.1
*gender difference**	*ns*		*ns*	
Maternal support (%)	*(n=508)*	*(n=551)*	*(n=481)*	*(n=530)*
High	54.7	54.3	56.1	50.6
Low	41.3	44.5	42.4	47.4
No mother	3.9	1.3	1.5	2.1
*gender difference**	$p<0.05$		*ns*	
Paternal support (%)	*(n=506)*	*(n=550)*	*(n=475)*	*(n=522)*
High	54.3	41.3	62.5	47.7
Low	35.6	51.3	28.8	43.1
No father	10.1	7.5	8.6	9.2
*gender difference**	$p<0.001$		$p<0.001$	
Older sibling support (%)	*(n=477)*	*(n=521)*	*(n=461)*	*(n=517)*
High	35.0	32.8	36.0	29.4
Low	28.5	26.5	26.9	29.0
No sibling	36.5	40.7	37.1	41.6
*gender difference**	*ns*		*ns*	
Peer support	*(n=506)*	*(n=553)*	*(n=491)*	*(n=549)*
Mean (SD)	3.34 (.72)	3.10 (.76)	3.24 (.75)	2.84 (.82)
gender difference$	$p<0.001$		$p<0.001$	
Peer socialising	*(n=506)*	*(n=551)*	*(n=487)*	*(n=545)*
Mean (SD)	3.52 (1.43)	3.19 (1.52)	3.69 (1.41)	3.56 (1.49)
gender difference$	$p<0.01$		*ns*	

** gender difference assessed by Chi-squared test*
$ gender difference assessed by Mann-Whitney U test

Table 16.2: Associations between social categorical variables and physical activity in BOYS

	P7		S2	
	n	Mean PAQ-C score (SD)	*n*	Mean PAQ-C score (SD)
Family structure				
Two-parent	*301*	3.07 (.82)	-	-
Single parent	*97*	3.14 (.77)	-	-
Step family	*40*	3.38 (.72)	-	-
*between group difference**		*ns*		
Family affluence				
Low	*100*	3.02 (.82)	*89*	3.04 (.81)
Medium	*231*	3.04 (.82)	*251*	2.98 (.82)
High	*111*	3.33 (.73)	*118*	3.04 (.72)
*between group difference**		*p<0.01*		*ns*
Maternal support				
High	*249*	3.27 (.75)	*252*	3.20 (.73)
Low	*174*	2.94 (.83)	*194*	2.86 (.84)
No mother	*18*	2.86 (.84)	*7*	2.72 (.62)
*between group difference**		*p<0.001*		*p<0.001*
Paternal support				
High	*241*	3.28 (.75)	*279*	3.20 (.75)
Low	*156*	2.88 (.85)	*131*	2.82 (.81)
No father	*41*	3.07 (.70)	*37*	2.76 (.82)
*between group difference**		*p<0.001*		*p<0.001*
Older sibling support				
High	*146*	3.25 (.77)	*156*	3.18 (.74)
Low	*119*	3.00 (.83)	*119*	2.89 (.85)
No sibling	*149*	3.07 (.79)	*159*	3.03 (.81)
*between group difference**		*p<0.05*		*p<0.05*

** between group differences assessed using one-way analysis of variance*

Table 16.3: Associations between social categorical variables and physical activity in GIRLS

	P7		S2	
	n	Mean PAQ-C score (SD)	*n*	Mean PAQ-C score (SD)
Family structure				
Two-parent	*367*	2.86 (.77)	-	-
Single parent	*80*	2.88 (.75)	-	-
Step family	*58*	2.61 (.79)	-	-
*between group difference**		*ns*		
Family affluence				
Low	*118*	2.66 (.77)	*116*	2.46 (.83)
Medium	*283*	2.86 (.79)	*289*	2.47 (.72)
High	*113*	2.90 (.75)	*122*	2.73 (.72)
*between group difference**		$p<0.05$		$p<0.01$
Maternal support				
High	*279*	3.02 (.76)	*262*	2.74 (.71)
Low	*226*	2.60 (.74)	*240*	2.31 (.74)
No mother	*6*	2.59 (.30)	*10*	2.22 (.74)
*between group difference**		$p<0.001$		$p<0.001$
Paternal support				
High	*207*	3.03 (.76)	*241*	2.71 (.74)
Low	*264*	2.72 (.75)	*215*	2.39 (.73)
No father	*38*	2.50 (.80)	*48*	2.24 (.69)
*between group difference**		$p<0.001$		$p<0.001$
Older sibling support				
High	*160*	3.01 (.75)	*147*	2.75 (.74)
Low	*124*	2.70 (.82)	*144*	2.38 (.72)
No sibling	*200*	2.76 (.75)	*207*	2.48 (.76)
*between group difference**		$p<0.01$		$p<0.001$

** between group differences assessed using one-way analysis of variance*

Table 16.4: Associations between psychological variables and physical activity: results from linear regression analyses among P7 BOYS

	n	β (95% CI)	B	F	$R^{2\ adj}$
Peer socialising	436	.220 (.173, .268)***	.399	82.31***	0.157
Peer support	438	.372(.272, .472)***	.331	53.70***	0.108
Paternal support	438			12.24***	0.049
High (reference)		0	0		
Low		-.399 (-.558, -.240)***	-.237		
No father		-.207 (-.469, .054)	-.075		
Maternal support	441			9.92***	0.039
High (reference)		0	0		
Low		-.327 (-.480, -.174)***	-.199		
No mother		-.411 (-.788, -.034)*	-.101		
Family affluence	442			5.97**	0.026
Low (reference)		0	0		
Medium		.029 (-.159, .216)	.018		
High		.321 (.105, .537)**	.173		
Older sibling support	414			3.52*	0.012
High (reference)		0	0		
Low		-.249 (-.442, -.055)*	-.141		
No sibling		-.177 (-.359, .005)	-.106		

Dependent variable = PAQ-C mean score
β = unstandardised coefficient, B = standardised coefficient, * $p<0.05$ ** $p<0.01$ *** $p<0.001$

Table 16.5: Associations between psychological variables and physical activity: results from linear regression analyses among S2 BOYS

	n	β (95% CI)	B	F	$R^{2\ adj}$
Peer socialising	457	.204 (.156, .252)***	.364	69.41***	0.130
Peer support	463	.352 (.260, .445)***	.328	55.62***	0.106
Paternal support	447			13.51***	0.053
High (reference)		0	0		
Low		-.378 (-.539, -.217)***	-.217		
No father		-.439 (-.705, -.173)**	-.152		
Maternal support	453			11.41***	0.044
High (reference)		0	0		
Low		-.346 (-.492, -.199)***	-.215		
No mother		-.486 (-1.073, .102)	-.075		
Older sibling support	434			4.67*	0.017
High (reference)		0	0		
Low		-.293 (-.483, -.103)**	-.164		
No sibling		-.156 (-.332, .020)	-.094		

Dependent variable = PAQ-C mean score
β = unstandardised coefficient, B = standardised coefficient, * $p<0.05$ ** $p<0.01$ *** $p<0.001$

Table 16.6: Associations between psychological variables and physical activity: results from linear regression analyses among P7 GIRLS

	n	β (95% CI)	B	F	$R^{2\ adj}$
Maternal support	511			20.09***	0.070
High (reference)		0	0		
Low		-.422 (-.554, -.290)***	-.270		
No mother		-.430 (-1.038, .178)	-.060		
Peer socialising	507	.129 (.085, .174)***	.247	32.77***	0.059
Paternal support	509			13.16***	0.046
High (reference)		0	0		
Low		-.304 (-.442, -.165)***	-.195		
No father		-.529 (-.792, -.265)***	-.179		
Peer support	513	.208 (.121, .295)***	.204	22.21***	0.040
Older sibling support	484			6.88**	0.024
High (reference)		0	0		
Low		-.305 (-.485, -.125)**	-.172		
No sibling		-.249 (-.409, -.090)**	-.158		
Family affluence	514			3.62*	0.010
Low (reference)		0	0		
Medium		.204 (.038, .371)*	.131		
High		.242 (.042, .442)*	.129		

Dependent variable = PAQ-C mean score
β = unstandardised coefficient, B = standardised coefficient, * *p<0.05* ** *p<0.01* *** *p<0.001*

Table 16.7: Associations between psychological variables and physical activity: results from linear regression analyses among S2 GIRLS

	n	β (95% CI)	B	F	$R^{2\ adj}$
Peer support	530	.294 (.220, .367)***	.322	61.08***	0.102
Maternal support	512			22.87***	0.079
High (reference)		0	0		
Low		-.429 (-.556, -.302)***	-.284		
No mother		-.518 (-.977, -.059)*	-.095		
Paternal support	504			15.12***	0.053
High (reference)		0	0		
Low		-.325 (-.460, -.189)***	-.213		
No father		-.470 (-.698, -.242)***	-.183		
Older sibling support	498			10.06***	0.035
High (reference)		0	0		
Low		-.374 (-.545, -.203)***	-.224		
No sibling		-.274 (-.432, -.116)**	-.179		
Family affluence	527			5.79**	0.018
Low (reference)		0	0		
Medium		.003 (-.157, .164)	.002		
High		.264 (.074, .453)**	.148		
Peer socialising	526	.054 (.011, .097)*	.108	6.14*	0.010

Dependent variable = PAQ-C mean score
β = unstandardised coefficient, B = standardised coefficient, * *p<0.05* ** *p<0.01* *** *p<0.001*

16.9 Multivariate analyses

Multiple regression analyses were undertaken with four separate models for P7 and S2 boys and P7 and S2 girls. Within each model, a staged process was undertaken using the 'enter' method and variables were entered into the model based on the R^2 value from linear regression analyses. Variables were entered into the model one at a time, with the variable with highest R^2 value entered first. Any variable which did not significantly improve the model was removed before the next variable was entered. Results from the multivariate analyses are shown in Tables 16.8 to 16.11. Regression analyses were also undertaken to test for interaction effects between social variables. The variable with the strongest effect in each of the four models was tested for interactions with other variables in the models. Correlation matrices for the final models are shown in Appendix 6.

The multivariate models were found to vary by gender and age. For P7 boys, six variables were entered into the model in the following order: peer socialising, peer support, paternal support, maternal support, family affluence and older sibling support. The variables remaining in the final model were peer socialising, peer support, family affluence and paternal support, with a total R^2 (adjusted) of 25.3% (Table 16.8). Higher levels of peer socialising, peer support and family affluence were all associated with increased physical activity. Low paternal support was associated with lower levels of physical activity. Visual inspection of the partial regression plots indicated there may be heteroscedasticity for the peer support variable. However, the Levene test for homogeneity of variance showed that this was not a significant effect.

For S2 boys, five variables were entered into the model in the following order: peer socialising, peer support, paternal support, maternal support and older sibling support. The final model was similar to that for P7 boys except that family affluence did not make a significant contribution. Variables remaining in the model for S2 boys were peer socialising, peer support and paternal support, with a total R^2

(adjusted) of 22.6% (Table 16.9). Within the final model, there was some indication of heteroscedasticity for both the peer support and peer socialising variables. The Levene test showed a significant effect for peer socialising. However, visual inspection of the partial regression plot suggested that the effect was not strong and was likely to be due to the small number of values at the lower end of the scale. Log transformation of the dependent variable made no improvement to either the distribution of residuals or the overall model fit. Therefore, peer socialising was kept in the final model for S2 boys. Within the multivariate model, support from mothers and older siblings did not have any significant effect on boys' physical activity in either P7 or S2.

Table 16.8: Multivariate model of social influences among P7 BOYS showing β coefficients (95% CI), n=414

	Model 1	Model 2	Model 3	Model 4
Peer socialising	.229 (.180, .278)***	.199 (.151, .247)***	.201 (.154, .249)***	.198 (.150, .245)***
Peer support		.275 (.176, .373)***	.272 (.175, .370)***	.235 (.134, .335)***
Family Affluence (low)			0	0
Medium FAS			.039 (-.134, .212)	.008 (-.166, .183)
High FAS			.299 (.103, .495)**	.271 (.072, .471)**
Paternal Support (high)				0
Low support				-.218 (-.368, -.067)**
No support				-.137 (-.382, .109)
				Final model R^2=0.264
				Final model R^2 adjusted = 0.253

Dependent variable = PAQ-C score, * p<0.05, ** p<0.01, ***p<0.001

Table 16.9: Multivariate model of social influences among S2 BOYS showing β coefficients (95% CI), n=438

	Model 1	Model 2	Model 3
Peer socialising	.210 (.162, .259) ***	.183 (.135, .231)***	.181 (.134, .228)***
Peer support		.277 (.185, .369)***	.230 (.136, .324)***
Paternal support (high)			0
Low support			-.248 (-.401, -.095)**
No support			-.362 (-.608, -.116)**
			Final model R^2=0.233
			Final model R^2 adjusted = 0.226

Dependent variable = PAQ-C score, * p<0.05, ** p<0.01, ***p<0.001

Social factors were also significant among girls but explained less of the total variance in physical activity than for boys. For P7 girls, six variables were entered into the model in the following order: maternal support, peer socialising, paternal support, peer support, older sibling support and family affluence. Only maternal support, peer socialising and paternal support made a significant contribution to the model, with a total R^2 (adjusted) of 13.9% (Table 16.10). Support from peers or older siblings and family affluence did not significantly improve the model.

For S2 girls, six variables were entered into the model in the following order: peer support, maternal support, paternal support, older sibling support, family affluence and peer socialising. Peer support, maternal support and paternal support all made a significant contribution to the model with a total R^2 (adjusted) of 14.0% (Table 16.11). It should be noted that the number of pupils who reported not having or not seeing their mother ('no support' group) in both years was too small to allow for meaningful interpretation of the data, as evidenced by the large confidence intervals. As in P7, support from older siblings and family affluence did not significantly improve the model.

The models also show some important gender differences. For example, maternal support was significant for girls but not boys. Spending time with friends after school was the most important factor for boys in both P7 and S2, whereas support for being active from friends and family appeared to be more important among girls. Paternal support was the only variable which remained significant in all four models although the relationship between children's physical activity and the level of support from their fathers varied by age and gender. For older girls in particular, having an absent father appears to be a greater disadvantage in relation to physical activity than receiving low levels of support from their father. The final models were re-run including interaction terms but no significant interaction effects were found in any of the four models.

Table 16.10: Multivariate model of social influences among P7 GIRLS showing β coefficients (95% CI), n=496

	Model 1	Model 2	Model 3
Maternal Support (high)	0	0	0
Low support	-.424 (-.599, -.290)***	-.405 (-.536, -.274)***	-.316 (-.464, -.169)***
No support	-.431 (-1.041, .179)	-.396 (-.989, .197)	-.057 (-.680, .565)
Peer socialising		.121 (.077, .164)***	.125 (.082, .168)***
Paternal Support (high)			0
Low support			-.167 (-.319, -.015)*
No support			-.465 (-.740, -.191)**
			Final model R^2=0.148
			Final model R^2 adjusted = 0.139

Dependent variable = PAQ-C score, * p<0.05, ** p<0.01, ***p<0.001

Table 16.11: Multivariate model of social influences among S2 GIRLS showing β coefficients (95% CI), n=499

	Model 1	Model 2	Model 3
Peer support	.295 (.218, .371)***	.236 (.156, .316)***	.238 (.158, .318)***
Maternal Support (high)	0	0	0
Low support		-.283 (-.416, -.150)***	-.251 (-.412, -.090)**
No support		-.253 (-.751, .245)	-.071 (-.581, .439)
Paternal Support (high)			0
Low support			-.046 (-.210, .118)
No support			-.334 (-.565, -.103)**
			Final model R^2=0.149
			Final model R^2 adjusted = 0.140

Dependent variable = PAQ-C score, * p<0.05, ** p<0.01, ***p<0.001

16.10 Summary of key findings

- Family structure was not associated with physical activity.
- Family affluence, support for being active from family members and friends and time spent with friends outside of school all showed significant associations with physical activity. The only exception was S2 boys for whom family affluence was not significant.
- Among boys, social variables accounted for around a quarter of the variance in physical activity behaviour in P7 (25%) and S2 (23%). The strongest factor was

peer socialising indicating that physical activity is a core element of male peer group culture in early adolescence.

- Among girls, social variables accounted for 14% of the total variance in physical activity behaviour in both P7 and S2, but developmental effects were evident. Among P7 girls, maternal support was the strongest factor but among S2 girls, support from peers showed the strongest influence on physical activity indicating a shift in influence from parents to friends as girls get older.

Chapter 17

Environmental model

17.1 Introduction

This chapter presents results from analyses of environmental factors and their relationship with physical activity. Five explanatory variables providing subjective assessments of aspects of the physical environment were included in the PASS study: availability of local facilities, access to local facilities, perceptions of the local neighbourhood, perceptions of neighbourhood safety and the reported amount of sports and games equipment at home. In the first part of the chapter, descriptive data and results from linear regression analyses are presented for each variable separately. Changes in the explanatory variables occurring between P7 and S2 were assessed using Wilcoxon Signed Rank Test or Paired Samples T-test, and are also reported. Results from multivariate analyses are presented in the second part of the chapter.

17.2 Availability of local facilities

Age and gender differences in reported availability of local facilities for sports and physical activity are shown in Table 17.1. There was a significant gender difference in perceived availability of local facilities in both P7 ($p<0.01$) and S2 ($p<0.05$), with boys more likely than girls to report that sports and physical activity facilities were available locally. Analysis of the six individual items included in this measure showed that the gender difference was only significant for playing fields and tennis courts (see Appendix 7). One possible explanation for this is that boys are more likely to make use of these facilities and are therefore more aware of their existence locally. Between P7 and S2, reported availability of facilities increased among both boys and girls ($p<0.001$), probably reflecting increased awareness rather than actual changes in provision. Overall, parks and playing fields were most frequently reported.

The association between availability mean score and physical activity was assessed using Spearman's rank correlation. A low but significant correlation was found for girls in both P7 and S2 and for boys in S2 only. Among girls, Spearman's rank correlation coefficient was 0.18 in P7 ($n=467$, $p<0.001$) and 0.13 in S2 ($n=458$, $p<0.01$). Among boys, the correlation coefficient was 0.08 in P7 ($n=394$, $p=0.10$) and 0.14 in S2 ($n=398$, $p<0.01$). As availability of local facilities was not associated with physical activity among P7 boys, it was excluded from further analyses within this group. Associations between availability of local facilities and physical activity were further explored using linear regression analyses. Results are shown in Tables 17.2 and 17.3. There was a significant positive relationship among boys in S2 and girls in P7 and S2, but this only accounted for between 1.4% and 3.1% of the total variance in PAQ-C score. The strongest effect was among P7 girls.

17.3 Access to local facilities

Age and gender differences in reported access to local facilities for sports and physical activity are shown in Table 17.1. There was a significant gender difference in S2 only, with boys more likely than girls to report easy access to facilities. Analysis of the six individual items included in this measure showed that, as with availability, the gender difference was only significant for playing fields and tennis courts (see Appendix 7). Between P7 and S2, reported ease of access to facilities increased among both boys and girls ($p<0.001$). In S2, over 90% of pupils said it was easy for them to get to a park or playing field and over 80% said it was easy to get to a sports centre or swimming pool.

The association between access to local facilities and physical activity was assessed using Spearman's rank correlation. A small but significant association was found for boys and girls in both P7 and S2. Among boys, Spearman's rank correlation coefficient was 0.17 in P7 ($n=396$, $p<0.01$) and 0.15 in S2 ($n=416$, $p<0.01$). Among girls, the correlation coefficient was 0.14 in P7 (n=469, $p<0.01$) and 0.18 in S2 (n=473, $p<0.001$). Associations were further explored using linear regression analyses. Results are shown in Tables 17.2 and 17.3. There was a significant positive relationship among all groups, accounting for between 2.2% and 3.7% of the total variance in PAQ-C score. The strongest effect was among S2 girls.

17.4 Perceptions of the local neighbourhood

Table 17.1 shows mean neighbourhood perception scores by age and gender. Girls had a significantly higher mean score in both P7 ($p<0.01$) and S2 ($p<0.01$) reflecting more positive perceptions of the local neighbourhood among girls than boys. Analysis of the individual items (see Appendix 7) showed that boys were more likely than girls to report the presence of groups of young people and groups of adults who cause trouble in both P7 and S2. Boys in P7 were also more likely than girls to report that there are a lot of run-down houses and litter or rubbish lying around, but there was no gender difference on these two items in S2. Between P7 and S2, neighbourhood perceptions mean score decreased significantly among boys and girls ($p<0.05$), reflecting an increase in more negative perceptions with age.

The association between neighbourhood perceptions mean score and physical activity was assessed using Spearman's rank correlation. A small but significant negative association was found for P7 boys only; Spearman's rank correlation coefficient was -0.12 (n=437, $p<0.05$). There was no significant correlation between neighbourhood perceptions and physical activity among P7 girls and S2 girls and boys, and therefore neighbourhood perceptions mean score was excluded from further analyses among these groups.

Among P7 boys, associations between neighbourhood perceptions and physical activity were further explored using linear regression analyses. Results are shown in Table 17.2. A significant negative relationship was found, but this accounted for only a very small proportion of the overall variance in physical activity behaviour (1.4%). This indicates that P7 boys with more positive perceptions of their local neighbourhood were less likely to be physically active than those with negative perceptions. This is somewhat surprising as it might be expected that children would be more active if their local neighbourhood was seen as attractive and conducive to play. However, it may be that those who are more active spend more time outdoors and consequently are more aware of the condition of their local area and some of the characteristics which are included in this measure, such as run-down houses or groups of young people causing trouble.

17.5 Perceived neighbourhood safety

Perceived safety was measured in relation to walking or cycling within the local neighbourhood. Table 17.1 shows mean neighbourhood safety scores (range 1-5) by age and gender. There was no significant gender difference in either P7 or S2. The association between neighbourhood safety and physical activity was assessed using Spearman's rank correlation. No significant correlation was found for either boys or girls in P7 or S2. Therefore perceptions of neighbourhood safety was excluded from further analyses.

17.6 Home equipment

Age and gender differences in the amount of sports and games equipment pupils reported having at home are shown in Table 17.1. There was a significant gender difference in P7 with boys more likely to report having sports and games equipment at home than girls ($p<0.001$). However, this difference disappeared in S2 as a result of an increase in the amount of home equipment among girls between P7 and S2 ($p<0.01$). There was no significant change among boys during this period. Analysis of the individual items (see Appendix 7) showed that, in P7, boys were more likely to have sports balls, a skateboard, skis or snowboard and weights at home while girls were more likely to have roller blades, roller skates or ice skates and report 'other' types of equipment at home. There was no significant gender difference in the possession of bicycles or racquets. In S2, boys were more likely to have a skateboard, skis or snowboard and weights, while girls were more likely to have a bicycle, racquets, roller blades, roller skates or ice skates and report 'other' types of equipment at home. There was no significant gender difference in the possession of sports balls in S2. Overall, the most common pieces of equipment were bicycles and sports balls.

The association between home equipment and physical activity was assessed using Pearson's r correlation. A significant association was found for boys and girls in both P7 and S2. Among boys, Pearson's correlation coefficient was 0.29 in P7 (n=446, $p<0.001$) and 0.16 in S2 (n=456, $p<0.01$). Among girls, the correlation coefficient was 0.15 in P7 (n=514, $p<0.01$) and 0.29 in S2 (n=522, $p<0.001$). This indicates age-related differences in the strength of association between home equipment and physical activity among both boys and girls. Among boys, there was a stronger correlation in P7 whereas, among girls, the correlation was stronger in S2.

Associations between home equipment and physical activity were further explored using linear regression analyses. Results are shown in Tables 17.2 and 17.3. The amount of sports and games equipment at home showed the strongest association with physical activity for both P7 boys and S2 girls, accounting for around 8% of the total variance in PAQ-C score. There was a weaker but still significant relationship among P7 girls and S2 boys, accounting for around 2% of the total variance. These findings suggest that the amount of equipment available at home may become less important to physical activity behaviour among boys, but more important for girls, as they get older.

Table 17.1: Gender differences in environmental variables

	BOYS		GIRLS		Gender difference[$]
	n	Mean (sd)	n	Mean (sd)	
P7					
Availability of local facilities	452	3.86 (1.60)	501	3.57 (1.60)	*p<0.01*
Access to local facilities	450	4.46 (1.40)	504	4.36 (1.34)	*ns*
Perceptions of neighbourhood	504	1.29 (0.52)	537	1.40 (0.44)	*p<0.01*
Perceptions of safety	505	4.17 (0.94)	546	4.10 (1.03)	*ns*
Home equipment	515	4.59 (1.52)	555	4.19 (1.49)	*p<0.001*
S2					
Availability of local facilities	422	4.25 (1.61)	474	4.05 (1.56)	*p<0.05*
Access to local facilities	440	4.93 (1.26)	490	4.69 (1.36)	*p<0.01*
Perceptions of neighbourhood	442	1.24 (0.54)	504	1.34 (0.50)	*p<0.01*
Perceptions of safety	465	4.16 (0.97)	522	4.10 (0.97)	*ns*
Home equipment	486	4.53 (1.56)	541	4.37 (1.50)	*ns*

[$] *Gender differences assessed using Mann-Whitney U test except for home equipment which was assessed using independent samples t-test (ns=not significant).*

Table 17.2: Associations between environmental variables and physical activity: results from linear regression analyses among BOYS

	n	β (95% CI)	B	F	$R^{2\ adj}$
P7 BOYS					
Home equipment	446	.150 (.103, .196)***	.288	40.053***	0.081
Access to local facilities	396	.099 (.041, .157)***	.166	11.139**	0.025
Perceptions of neighbourhood	437	-.190 (-.331, -.050)**	-.127	7.103**	0.014
S2 BOYS					
Access to local facilities	416	.115 (.055, .175)***	.182	14.185***	0.031
Home equipment	456	.083 (.036, .130)**	.161	12.145**	0.024
Availability of local facilities	398	.064 (.016, .112)*	.130	6.759*	0.014

Dependent variable: PAQ-C mean score

β = unstandardised coefficient, B = standardised coefficient, * *p<0.05* ** *p<0.01* *** *p<0.001*

Table 17.3: Associations between environmental variables and physical activity: results from linear regression analyses among GIRLS

	n	β (95% CI)	B	F	$R^{2\ adj}$
P7 GIRLS					
Availability of local facilities	467	.089 (.045, .134)***	.181	15.830***	0.031
Access to local facilities	469	.088 (.037, .140)**	.154	11.293**	0.022
Home equipment	514	.078 (.032, .123)**	.147	11.379**	0.020
S2 GIRLS					
Home equipment	522	.147 (.106, .188)***	.294	49.019***	0.084
Access to local facilities	473	.111 (.061, .161)***	.197	19.046***	0.037
Availability of local facilities	458	.066 (.022, .110)**	.136	8.632**	0.016

Dependent variable: PAQ-C mean score
β = unstandardised coefficient, B = standardised coefficient, * *p<0.05* ** *p<0.01* *** *p<0.001*

17.7 Multivariate analyses

Multiple regression analyses were undertaken with four separate models for P7 and S2 boys and P7 and S2 girls. As before, a staged process was undertaken using the 'enter' method and variables were entered into the model based on the R^2 value from linear regression analyses. Variables were entered into the model one at a time, with the variable with highest R^2 value entered first. Any variable which did not significantly improve the model was removed before the next variable was entered. Results from the multivariate analyses are shown in Tables 17.4 to 17.7. Regression analyses were also undertaken to test for interaction effects between the independent variables. Correlation matrices for the final models are shown in Appendix 6.

For P7 boys, three variables were entered into the model in the following order: home equipment, access to local facilities and neighbourhood perceptions. Only home equipment and neighbourhood perceptions made a significant contribution to the model. The amount of sports and games equipment within the home was positively associated with physical activity, and had the strongest effect in the model. Conversely, perceptions of the local neighbourhood were negatively associated with physical activity. The analysis was re-run including the interaction term for home equipment x neighbourhood perceptions. No significant interaction effect was found. The final model explained 9.7% of the total variance in PAQ-C score (Table 17.4).

For S2 boys, three variables were entered into the model in the following order: access to local facilities, home equipment and availability. Only access and home equipment made a significant contribution to the model. Having easy access to facilities in the local area and sports and games equipment at home were positively associated with physical activity. The analysis was re-run including the interaction term for access x home equipment. No significant interaction effect was found. The final model explained 5.4% of the total variance in PAQ-C score (Table 17.5).

For P7 girls, three variables were entered into the model in the following order: availability of local facilities, access and home equipment. Only availability and home equipment remained in the model, with both showing a positive relationship with physical activity. Availability of local facilities had the strongest effect. The analysis was re-run including the interaction term for availability and home equipment but no significant effect was found. The final model explained 4.1% of the total variance in PAQ-C score (Table 17.6).

For S2 girls, three variables were entered into the model in the following order: home equipment, access and availability. Only home equipment and access remained in the model, with both showing a positive relationship with physical activity. Home equipment had the strongest effect. The analysis was re-run including the interaction term for home equipment and access but no significant effect was found. The final model explained 9.3% of the total variance in PAQ-C score (Table 17.7).

Table 17.4: Multivariate model of environmental influences among P7 BOYS (n=434) showing β coefficients (95% CI)

	Model 1	Model 2
Home equipment	.145 (.098, .192)***	.151 (.104, .197)***
Neighbourhood perceptions		-.223 (-.359, -.088)**
		Final model R^2***=0.101***
		Final model R^2 ***adjusted = 0.097***

Dependent variable = PAQ-C mean score, * p<0.05, ** p<0.01, ***p<0.001

Table 17.5: Multivariate model of environmental influences among S2 BOYS (n=414) showing β coefficients (95% CI)

	Model 1	Model 2
Access	.117 (.057, .177) ***	.101 (.040, .161)**
Home equipment		.082 (.032, .133)**
		Final model R^2***=0.058***
		Final model R^2 ***adjusted = 0.054***

Dependent variable = PAQ-C mean score, * p<0.05, ** p<0.01, ***p<0.001

Table 17.6: Multivariate model of environmental influences among P7 GIRLS (n=465) showing β coefficients (95% CI)

	Model 1	Model 2
Availability	.091 (.047, .135)***	.083 (.039, .127)***
Home equipment		.057 (.009, .105)*
		Final model R^2***=0.045***
		Final model R^2 ***adjusted = 0.041***

Dependent variable = PAQ-C mean score, * p<0.05, ** p<0.01, ***p<0.001

Table 17.7: Multivariate model of environmental influences among S2 GIRLS (n=469) showing β coefficients (95% CI)

	Model 1	Model 2
Home equipment	.140 (.096, .185)***	.130 (.085, .174)***
Access		.083 (.033, .132)**
		Final model R^2***=0.096***
		Final model R^2 ***adjusted = 0.093***

Dependent variable = PAQ-C mean score, * p<0.05, ** p<0.01, ***p<0.001

17.8 Summary of key findings

- Among boys and girls, environmental factors accounted for less than 10% of the variance in physical activity behaviour.
- The amount of sports and games equipment at home was the only factor present in all four multivariate models.
- In P7 and S2, boys reported greater availability of local sports facilities but had more negative perceptions of their local neighbourhood than girls. In P7 only, boys reported having more sports and games equipment at home than girls. In S2 only, boys were more likely than girls to report easy access to local sports facilities.
- Overall, having access to facilities and equipment for sports and physical activity appears to be more important than adolescents' views about the neighbourhood in which they live.

Chapter 18

Integrative psycho-socio-environmental models

18.1 Introduction

This chapter presents results of modelling the combined effects of psychological, social and environmental factors on physical activity (PAQ-C score). Variables which were found to be significant within the multiple regression models presented in Chapters 15 to 17 were integrated into combined psycho-socio-environmental models, run separately for boys and girls in both P7 and S2. At this stage of the analyses, variables were added to the models in three blocks: (1) psychological variables, (2) social variables, and (3) environmental variables. This analysis was initially carried out by multiple regression analyses. It was then re-run using multilevel modelling in order to take account of potential clustering effects of groups of pupils nested within the same school. No school level effects were found.

18.2 Integrative model for P7 boys

Based on results from the three separate models presented previously, a total of eleven variables were found to be significantly associated with physical activity among P7 boys and subsequently included in the combined model. Variables entered into the model were as follows:

Psychological factors:

- Perceived competence
- Current intention
- Perceived benefits-barriers differential
- Enjoyment
- Self-efficacy

Social factors:

- Peer socialising
- Peer support
- Family affluence
- Paternal support

Environmental factors:

- Home equipment
- Neighbourhood perceptions

The stages involved in building the final model for P7 boys are shown in Table 18.1. The first column (Model 1) shows psychological variables only. As reported previously, these explained 33.1% of the variance in PAQ-C score. In Model 2, social variables were added and the proportion of variance explained increased to 41.4%. At this stage, the perceived benefits-barriers differential, family affluence and paternal support dropped out of the model. In Model 3, environmental variables were added but only home equipment remained significant. Six variables remained in the final model at this stage as follows: perceived competence, current intention, self-efficacy, enjoyment, peer socialising and home equipment. Peer support dropped out of Model 3 but was only marginally non-significant. Therefore the final model was re-run with the six significant variables plus peer support. All seven variables were found to be significant and this final model accounted for 41.2% of the total variance in PAQ-C score. No significant interaction effects were found. Inspection of the standardised beta coefficients showed that peer socialising had the strongest effect on PAQ-C score overall. The correlation matrix for the final model is shown in Appendix 6.

18.3 Integrative model for S2 boys

Based on results from the three separate models presented previously, a total of nine variables were found to be significantly associated with physical activity among S2 boys and subsequently included in the combined model. Variables entered into the model were as follows:

Psychological factors:

- Current intention
- Perceived benefits-barriers differential
- Self-efficacy
- Perceived competence

Social factors:

- Peer socialising
- Peer support
- Paternal support

Environmental factors:

- Home equipment
- Access to local facilities

The stages involved in building the final model for S2 boys are shown in Table 18.2. The first column (Model 1) shows psychological variables only. As reported previously, these explained 36.1% of the variance in PAQ-C score. In Model 2, social variables were added and the proportion of variance explained increased to 41.4%. At this stage, the perceived benefits-barriers differential and perceived competence dropped out of the model. When environmental variables were added (Model 3), the benefits-barriers differential became significant again but peer support dropped out. Neither of the environmental variables made a significant contribution to the model. Five variables remained in the final model at this stage as follows: current intention, benefits-barriers differential, self-efficacy, peer socialising and paternal support. Peer support dropped out in Model 3 but was only marginally non-significant. Therefore the final model was re-run with the five significant variables plus peer support. All six variables were found to be significant and this final model accounted for 41.6% of the total variance in PAQ-C score. No significant interaction effects were found. Inspection of the standardised beta coefficients showed that current intention had the strongest effect on PAQ-C score overall. The correlation matrix for the final model is shown in Appendix 6.

18.4 Integrative model for P7 girls

Based on results from the three separate models presented previously, a total of nine variables were found to be significantly associated with physical activity among P7 girls and subsequently included in the combined model. Variables entered into the model were as follows:

Psychological factors:

- Perceived benefits-barriers differential
- Perceived competence
- Benefits-barriers differential x perceived competence interaction term
- Current intention
- Enjoyment

Social factors:

- Maternal support
- Peer socialising
- Paternal support

Environmental factors:

- Home equipment
- Availability of local facilities

The stages involved in building the final model for P7 girls are shown in Table 18.3. The first column (Model 1) shows psychological variables only. Together, perceived benefits-barriers differential, perceived competence, current intention and enjoyment explained 30.4% of the variance in PAQ-C score. Neither the perceived benefits-barriers differential nor perceived competence had a significant independent effect but the interaction between these two variables was significant. In Model 2, social variables were added and the variance explained increased to 33.7%. At this stage, maternal support and peer socialising both made a significant contribution but paternal support dropped out of the model. The two environmental variables were added to Model 3 but only availability of local facilities significantly improved the model. Variables remaining in the model at this stage were the benefits-barriers x perceived competence interaction, intention, peer socialising and availability. The model was re-run with these four variables plus maternal support which was only marginally non-significant in Model 3. These five variables were all found to be significant and this final model accounted for 34.8% of the total variance in PAQ-C score. Inspection of the standardised beta coefficients showed that the interaction between perceived benefits-barriers and perceived competence had the strongest effect on PAQ-C score, followed by current intention and peer socialising. The correlation matrix for the final model is shown in Appendix 6.

18.5 Integrative model for S2 girls

Based on results from the three separate models presented previously, a total of eight variables were found to be significantly associated with physical activity among S2 girls and subsequently included in the combined model. Variables entered into the model were as follows:

Psychological factors:

- Self-efficacy
- Current intention
- Enjoyment

Social factors:

- Peer support
- Maternal support
- Paternal support

Environmental factors:

- Home equipment
- Access to local facilities

The stages involved in building the final model for S2 girls are shown in Table 18.4. The first column (Model 1) shows psychological variables only. Together, self-efficacy, intention and enjoyment explained 28.6% of the variance in PAQ-C score. In Model 2, social variables were added and the variance explained increased to 31.4% but only peer support made a significant contribution. Both maternal and paternal support dropped out of the model at this stage. The two environmental variables were then added (Model 3) but only home equipment remained significant. Thus, variables remaining in the final model were self-efficacy, current intention, enjoyment, peer support and home equipment. Together these accounted for 34.4% of the total variance in PAQ-C score. Inspection of the standardised beta coefficients showed that current intention had the strongest effect on PAQ-C score overall. S2 girls who reported high exercise self-efficacy, high enjoyment of physical activity, high levels of peer support for being active and a greater amount of sports and games equipment at home were most likely to be physically active. No significant interaction effects were found. The correlation matrix for the final model is shown in Appendix 6.

18.6 Summary of key findings

- Age and gender moderated the relationships between explanatory variables and physical activity.
- Among P7 boys, perceived competence, intention, self-efficacy, enjoyment, peer socialising, peer support and home equipment made a significant contribution to the integrative model. Of these, peer socialising had the strongest effect.
- Among S2 boys, intention, perceived benefits-barriers, self-efficacy, peer socialising, peer support and paternal support made a significant contribution to the integrative model. Of these, intention had the strongest effect.
- Among P7 girls, intention, peer socialising, maternal support, availability of local facilities and the interaction between perceived benefits-barriers and perceived competence made a significant contribution to the integrative model. Of these, the perceived benefits-barriers x perceived competence interaction term had the strongest effect.
- Among S2 girls, self-efficacy, intention, enjoyment, peer support and home equipment made a significant contribution to the integrative model. Of these, intention had the strongest effect.
- The models each explained between 34%-42% of total variance in PAQ-C score.
- In all four models, psychological variables made the strongest contribution.
- Intention to be active was the most consistent correlate of physical activity.

Table 18.1 Final integrative model for P7 BOYS showing unstandardised β coefficients (95% CI)

	Model 1 (n=415)	**Model 2 (n=377)**	**Model 3 (n=369)**	**FINAL MODEL (n=417)**
Constant	.947	.637	.702	.355
Perceived competence	.354 (.192, .515)***	.216 (.049, .384)*	.191 (.019, .363)*	.241 (.085, .396)**
Intention (high)	.343 (.190, .495)***	.325 (.174, .476)***	.321 (.168, .473)***	.360 (.218, .502)***
Benefits-barriers differential	.138 (.048, .228)**	.078 (-.012, .168)	.075 (-.016, .166)	
Self-efficacy	.146 (.007, .284)*	.152 (.014, .290)*	.153 (.014, .292)*	.152 (.030, .274)*
Enjoyment (high)	.240 (.071, .410)**	.215 (.047, .384)*	.207 (.036, .377)*	.196 (.042. .349)*
Peer socialising		.146 (.100, .192)***	.135 (.087, .182)***	.142 (.098, 186)***
Peer support		.104 (.010, .199)*	.092 (-.003, .188)	.141 (.051, .230)**
Family affluence (reference = low)		0	0	
Medium		-.055 (-.216, .106)	-.087 (-.251, .078)	
High		.174 (-.015, .363)	.120 (-.078, .318)	
Paternal support (reference = high)		0	0	
Low		-.036 (-.184, .113)	-.026 (-.178, .125)	
None		-.029 (-.264, .207)	-.025 (-.265, .215)	
Home equipment			0.047 (.000, .095)*	.051 (.010, .092)*
Neighbourhood perceptions			-0.066 (-.197, .064)	
R^2 (adjusted)	**0.331**	**0.414**	**0.410**	**0.412**

Dependent Variable: PAQ-C mean score, * $p<0.05$ ** $p<0.01$ *** $p<0.001$

Table 18.2 Final integrative model for S2 BOYS showing unstandardised β coefficients (95% CI)

	Model 1 (n=489)	**Model 2 (n=430)**	**Model 3 (n=394)**	**FINAL MODEL (n=431)**
Constant	1.399	1.110	1.177	1.167
Intention (high)	.543 (.408, .678)***	.496 (.357, .635)***	.491 (.346, .635)***	.500 (.362, .638)***
Benefits-barriers differential	.133 (.053, .212)**	.080 (-.003, .163)	.094 (.007, .181)*	.086 (.006, .166)*
Self-efficacy	.253 (.117, .389)***	.277 (.138, .416)***	.276 (.128, .424)***	.288 (.156, .419)***
Perceived competence	.134 (.003, .265)*	.034 (-.099, .167)	.013 (-.129, .155)	
Peer socialising		.107 (.063, .151)***	.120 (.074, .166)***	.109 (.066, .152)***
Peer support		.095 (.008, .183)*	.093 (-.001, .186)	.097 (.010, .184)*
Paternal support (reference = high)		0	0	0
Low		-.154 (-.290, -.018)*	-.165 (-.311, -.020)*	-.159 (-.293, -.024)*
None		-.202 (-.421, .016)	-.221 (-.443, .002)	-.205 (-.422, .013)
Access to local facilities			-.008 (-.059, .043)	
Home equipment			.002 (-.041, .045)	
R^2 (adjusted)	**0.361**	**0.414**	**0.420**	**0.416**

Dependent Variable: PAQ-C mean score, * p<0.05 ** p<0.01 *** p<0.001

Table 18.3 Final integrative model for P7 GIRLS showing unstandardised β coefficients (95% CI)

	Model 1 (n=480)	Model 2 (n=456)	Model 3 (n=414)	FINAL MODEL (n=417)
Constant	2.119	2.167	2.022	1.985
Benefits-barriers differential	-.183 (-.499, .132)	-.223 (-.545, .098)	-.223 (-.556, .109)	-.197 (-.527, .132)
Perceived competence	.034 (-.141, .210)	-.022 (.-200, .157)	-.023 (-.209, .163)	.007 (-.172, .186)
Benefits-barriers x competence interaction	.139 (.036, .243)**	.143 (.038, .248)**	.146 (.038, .255)**	.144 (.036, .252)**
Intention (high)	.363 (.221, .504)***	.361 (.218, .504)***	.350 (.202, .498)***	.365 (.218, .511)***
Enjoyment (high)	.173 (.025, .321)*	.135 (-.016, .285)	.104 (-.054, .262)	
Maternal support (reference = high)		0	0	0
Low		-.153 (-.292, -.014)*	-.142 (-.287, .003)	-.161 (-.293, -.030)*
None		-.045 (-.596, .505)	.033 (-.558, .623)	-.126 (-.688, .435)
Peer socialising		.088 (.047, .128)***	.085 (.042, .127)***	.080 (.037, .122)***
Paternal support (reference = high)		0	0	
Low		-.023 (-.164, .117)	-.022 (-.170, .127)	
None		-.208 (-.463, .048)	-.216 (-.478, .046)	
Availability of local facilities			.042 (.001, .082)*	.044 (.004, .083)*
Home equipment			.005 (-.039, .049)	
R^2 (adjusted)	**0.304**	**0.337**	**0.348**	**0.348**

Dependent Variable: PAQ-C mean score, * $p<0.05$ ** $p<0.01$ *** $p<0.001$

Table 18.4 Final integrative model for S2 GIRLS showing unstandardised β coefficients (95% CI)

	Model 1 (n=549)	**Model 2 (n=499)**	**Model 3 (n=454)**	**FINAL MODEL (n=520)**
Constant	1.010	1.324	.942	.940
Self-efficacy	.312 (.211, .413)***	.243 (.133, .353)***	.215 (.099, .330)***	.232 (.127, .336)***
Intention (high)	.461 (.317, .605)***	.485 (.333, .637)***	.474 (.321, .628)***	.472 (.329, .614)***
Enjoyment (high)	.244 (.121, .367)***	.194 (.064, .324)**	.197 (.063, .331)**	.194 (.070, .317)**
Peer support		.126 (.052, .201)**	.119 (.041, .196)**	.124 (.055, .193)***
Maternal support (reference = high)		0	0	
Low		-.126 (-.272, .020)	-.080 (-.230, .069)	
None		.037 (-.420, .493)	.161 (-.349, .671)	
Paternal support (reference = high)		0	0	
Low		.076 (-.072, .224)	.092 (-.059, .244)	
None		-.132 (-.342, .078)	-.060 (-.280, .161)	
Home equipment			.083 (.043, .124)***	.085 (.049, .121)***
Access to local facilities			.017 (-.028, .062)	
R^2 (adjusted)	**0.286**	**0.314**	**0.331**	**0.344**

Dependent Variable: PAQ-C mean score, * p<0.05 ** p<0.01 *** p<0.001

Chapter 19

Predictors of physical activity in the early secondary school years

19.1 Introduction

Identifying factors that are related to falling levels of physical activity participation is an important step in developing interventions to prevent the decline (Sallis *et al.*, 1999). While behavioural research is limited in its ability to determine causation, longitudinal data can be used to predict outcomes from variables measured at a previous time point. This chapter presents the results of longitudinal analyses to investigate P7 predictors of physical activity in the early secondary school years. The primary aim of the analysis was to determine which (if any) P7 variables predict physical activity in S2. A secondary aim was to determine whether residual effects of P7 predictors on S2 behaviour can be identified after controlling for the same variables as measured in S2 and baseline physical activity in P7.

19.2 Analytic approach

In deciding on an appropriate analysis strategy, the option to look at changes in scores was explored. However, several problematic issues were identified. Firstly, regression to the mean occurred whereby those with the lowest scores on explanatory variables in P7 were most likely to show an increase in these scores over time but levels of physical activity typically remained low among this group. Secondly, variation in baseline physical activity created problems in computing change scores. An individual physical activity change score variable was computed by subtracting the P7 PAQ-C mean score from the S2 PAQ-C mean score. However, those who showed no change in PAQ-C score over time included pupils who were low active in both years as well as those who were high active in both years, thus potentially masking important effects. For these reasons, it was decided to use S2 physical activity as the dependent variable in the final model. Predictors of current physical activity, rather than change in physical activity, may also be considered more meaningful from an intervention perspective. By including P7 physical activity and explanatory variables in the final model, however, changes over time were accounted for.

The analyses involved three stages. Firstly, the effects of P7 predictors on S2 physical activity were examined (Model 1). Secondly, associations between P7 predictors and S2 physical activity were re-examined, controlling for S2 predictors (Model 2). Finally, baseline physical activity was included in the model (Model 3). The outcome variable was S2 PAQ-C mean score. Entering P7 predictors into the model first allows for identification of those P7 variables which are related to physical activity across the primary-secondary transition period. Identifying factors at P7 which are significantly associated with later physical activity may aid early intervention to prevent the decrease in physical activity which is typically observed following the transition to secondary school. P7 variables which drop out of the model when P7 physical activity is added are likely to be highly correlated with P7 physical activity and therefore are themselves important from an intervention perspective when targeting physical activity in the upper primary years. Models 1 and 2 allow for more detailed understanding of the complex inter-relationships between variables in P7 and S2 and the observed differences between boys and girls. If P7 physical activity were entered into the model first, identification of potentially important P7 predictors would not be possible. Multilevel analysis was undertaken, using MLWin v1.1, in order to test for school level effects. School effects were assessed at the level of the school cluster i.e. each secondary school and its associated primary schools were considered as a unit. Multilevel regression models were fitted separately for boys and girls.

Initially, the models were run using all cases in the longitudinal sample (529 boys and 570 girls). However, this meant that the sample for each of the three models varied depending on the number of missing values for each new variable added.

Thus, for the final models presented in Tables 19.1 and 19.2, cases with missing data on all individual level predictors, except those represented by dummy variables, were excluded. The final sample was therefore 359 for boys and 456 for girls, representing a reduction in the sample of 32% and 20%, respectively.

19.3 Predictors of S2 physical activity among boys

As a preliminary step, linear regression analyses were undertaken for all P7 independent variables to identify those which were significantly associated with S2 PAQ-C score. Among boys, the following variables were found to have no significant effect and were therefore excluded from subsequent analyses: self-esteem, body satisfaction, older sibling support, family affluence, neighbourhood perceptions, neighbourhood safety and availability of local facilities. Thus, the following variables were entered into the model:

Psychological

- Enjoyment
- Intention
- Perceived competence
- Self-efficacy
- Benefits-barriers differential
- Physical self worth
- Body image

Social

- Peer support
- Peer socialising
- Maternal support
- Paternal support

Environmental

- Home equipment
- Access to local facilities

Table 19.1 presents the results of the analyses for boys. Model 1 shows that four P7 variables predicted S2 PAQ-C score; self-efficacy, intention, peer socialising and body image. All variables were positively associated with physical activity with the exception of body image. In relation to body image, boys who perceived themselves as 'too thin' in P7 were less physically active in S2. Perceiving oneself as too fat in P7 was not significantly associated with S2 PAQ-C score. However, there *was* a significant negative effect of perceiving oneself as 'too fat' when body image was added to the model on its own. The fact that this effect disappeared when the other variables were included in the model suggests that these other factors may explain the lower levels of physical activity among those boys who perceived themselves to be too fat. Of the P7 predictors, self-efficacy had the strongest overall effect.

In Model 2, the S2 values for the four significant P7 variables were added. All P7 variables remained significant except for intention to be active, indicating an independent effect of these P7 factors on S2 physical activity which is not explained by the equivalent S2 factors. In addition, all S2 variables had a significant effect on S2 PAQ-C score. As before, all variables were positively associated with physical activity with the exception of body image. However, the effect of perceived body image in S2 was different from that in P7. In S2, there was no significant effect of being too thin, but boys who perceived themselves as too fat were less active. This effect was small but significant. S2 intention to be active had the strongest effect on PAQ-C score overall.

Finally, in Model 3, baseline (P7) physical activity was also added to the model. At this stage, the effects of all P7 explanatory variables disappeared, with the exception of body image. There was still a small, but significant, negative effect of perceiving oneself as too thin in P7 on physical activity in S2. Self-efficacy, intention and peer socialising in S2 all remained significant, even after controlling for previous physical activity. S2 intention had the strongest effect within the model, accounting for a greater proportion of the variance than P7 physical activity.

There was no significant school level variance in physical activity among boys.

Table 19.1: Predictors of S2 physical activity among BOYS (n=359)			
	Model 1	**Model 2**	**Model 3**
	β (SE)	**β (SE)**	**β (SE)**
Fixed effects			
intercept	1.705 (0.237)	0.931 (0.272)	0.648 (0.273)
P7 self-efficacy	0.282 (0.072)*	0.150 (0.063)*	0.097 (0.063)
P7 peer socialising	0.127 (0.028)*	0.065 (0.026)*	0.030 (0.027)
P7 intention	0.254 (0.084)*	0.080 (0.074)	-0.020 (0.076)
P7 body image			
about right (reference)	0	0	0
too thin	-0.319 (0.111)*	-0.246 (0.115)*	-0.226 (0.112)*
too fat	-0.046 (0.094)	0.126 (0.092)	0.140 (0.090)
S2 self-efficacy		0.291 (0.071)*	0.265 (0.069)*
S2 peer socialising		0.090 (0.027)*	0.088 (0.026)*
S2 intention		0.518 (0.075)*	0.515 (0.073)*
S2 body image			
about right (reference)		0	0
too thin		0.039 (0.117)	0.060 (0.114)
too fat		-0.176 (0.088)*	-0.161 (0.086)
P7 physical activity			0.216 (0.050)*
Random effects			
School level variance (SE)	0.024 (0.061)	0.010 (0.043)	0.002 (0.041)

Dependent variable = PAQ-C mean score, * significant at $p<0.05$ level

19.4 Predictors of S2 physical activity among girls

As a preliminary step, linear regression analyses were undertaken for all P7 independent variables to identify which of these were significantly associated with S2 PAQ-C score. The following variables were found to have no significant effect and were therefore excluded from subsequent analyses: body image, body satisfaction, older sibling support, neighbourhood perceptions, neighbourhood safety and the interaction term for perceived competence x benefits-barriers differential. In addition, self-esteem was excluded due to its high correlation with physical self worth. Thus, the following variables were entered into the model:

Psychological	Social	Environmental
• Enjoyment • Intention • Perceived competence • Self-efficacy • Benefits-barriers differential • Physical self worth	• Peer support • Peer socialising • Maternal support • Paternal support • Family affluence	• Home equipment • Availability of local facilities • Access to local facilities

Table 19.2 presents the results of the multilevel analyses for girls. Model 1 shows that four P7 variables predicted S2 PAQ-C score: intention, self-efficacy, peer socialising and home equipment. All variables were positively related to physical activity, such that higher scores were associated with higher levels of physical activity. Of these, intention to be active had the strongest overall effect on the model.

In Model 2, the S2 values for the four significant P7 variables were added. At this stage, P7 intention and P7 peer socialising both remained significant indicating that these variables have an independent effect on S2 physical activity which is not explained by the equivalent S2 factors. P7 girls who intend to be active in their free time and who spend a lot of time with their friends after school are more likely to be physically active in S2. P7 self-efficacy and home equipment dropped out of the model. All S2 variables made a significant contribution to the model with the exception of peer socialising. In Model 2, S2 self-efficacy had the strongest effect on the model, followed by S2 intention.

Finally, in Model 3, baseline (P7) physical activity was also added to the model. At this stage, the effects of all four P7 independent variables disappeared suggesting that the influence of these factors on S2 physical activity may be explained by levels of physical activity in P7. S2 intention, self-efficacy and home equipment all remained significant when controlling for P7 physical activity. S2 intention and self-efficacy both accounted for a greater proportion of the variance in S2 PAQ-C mean score than P7 physical activity and, of these, self-efficacy had the strongest effect.

There was no significant school level variance in physical activity among girls.

Table 19.2: Predictors of S2 physical activity among GIRLS (n=456)			
	Model 1	**Model 2**	**Model 3**
	β (SE)	**β (SE)**	**β (SE)**
Fixed effects			
intercept	1.494 (0.198)	0.941 (0.207)	0.744 (0.207)
P7 intention	0.336 (0.075)*	0.198 (0.068)*	0.101 (0.069)
P7 self-efficacy	0.170 (0.061)*	-0.033 (0.057)	-0.074 (0.057)
P7 peer socialising	0.059 (0.022)*	0.051 (0.022)*	0.034 (0.022)
P7 home equipment	0.056 (0.023)*	0.003 (0.022)	-0.001 (0.022)
S2 intention		0.435 (0.080)*	0.416 (0.078)*
S2 self-efficacy		0.349 (0.055)*	0.325 (0.054)*
S2 peer socialising		-0.005 (0.022)	-0.013 (0.022)
S2 home equipment		0.087 (0.022)*	0.079 (0.022)*
P7 physical activity			0.196 (0.043)*
Random effects			
School level variance (SE)	0.011 (0.010)	0.007 (0.007)	0.007 (0.007)

Dependent variable = PAQ-C mean score, * significant at $p<0.05$ level

19.5 Gender differences

The models presented in Tables 19.1 and 19.2 show that there are, in fact, considerable similarities between boys and girls in the predictors of physical activity across the primary-secondary school transition. Among both genders, intention to be active, self-efficacy and peer socialising in P7 were all found to predict physical activity behaviour in S2. Furthermore, for both boys and girls, the effect of P7 peer socialising remained significant even after controlling for S2 peer socialising. While time spent with friends in P7 and S2 were both independently associated with physical activity in S2 among boys, only P7 socialising predicted S2 physical activity among girls.

Other important gender differences were also found. Perceived body image in P7 predicted S2 physical activity among boys but not girls, with boys who perceive themselves as too thin in P7 being particularly at risk of lower participation in subsequent years. Among girls, the amount of sports and games equipment at home in P7 had a significant effect on S2 physical activity, but this was not the case for boys. These results reinforce the need to examine determinants of physical activity behaviour separately for boys and girls and to tailor interventions accordingly.

19.6 Summary of key findings

- There were no significant school effects on physical activity.
- Intention to be active, exercise self-efficacy and peer socialising in P7 predicted physical activity in S2 among both boys and girls.
- Perceiving oneself to be too thin in P7 was negatively associated with S2 physical activity among boys only. This effect remained significant even after controlling for S2 body image and P7 physical activity.
- The amount of sports and games equipment at home in P7 predicted S2 physical activity among girls only, but this effect disappeared after controlling for S2 home equipment.
- Among boys, S2 intention was the strongest predictor of S2 physical activity, after controlling for P7 physical activity.
- Among girls, S2 self-efficacy was the strongest predictor of S2 physical activity, after controlling for P7 physical activity.

Section 4

DISCUSSION and CONCLUSIONS

Chapter 20

Discussion

"Early identification and modification of physical activity determinants in children and youth has promise for both immediate and long-term benefits for personal and public health and wellbeing"
(Mummery *et al.*, 2000, p.116)

20.1 Introduction

The primary aim of this study was to investigate associations between theoretically-derived psychosocial and environmental variables and physical activity in order to improve understanding and prediction of physical activity behaviour among early adolescents in Scotland. Current data, from national surveys such as HBSC and the Scottish Health Survey, show that children tend to become less active as they make the transition to secondary school and these declines continue through the teenage years. Thus, interventions to promote physical activity are required among this age group. Development of effective interventions must be informed by empirical evidence. Physical activity is a complex behaviour which has been associated with a range of psychological, social and environmental factors. However, previous research in this area has tended to be limited by disciplinary boundaries. Among children and adolescents, very few studies have attempted to integrate different theoretical perspectives and investigate the potential influence of a wide range of factors within an ecological framework. A poly-theoretical approach is advocated in order to enhance the predictive value of behavioural models (Baranowski *et al.*, 1998). Similarly, Weiss has argued that "*a multidisciplinary perspective is necessary for best understanding children's participation patterns and performance*" (Weiss, 1991, p.337). Furthermore, in addition to a lack of cross-disciplinary integration, there has been little attempt to develop theoretical models separately for boys and girls; yet many have indicated that the determinants of physical activity behaviour vary by gender.

The research presented here investigated potential determinants of physical activity taking into account age and gender, as it is likely that both these factors moderate the influences on physical activity during the early adolescent years. The study is unique in providing longitudinal data from a cohort of early adolescents in Scotland. This chapter highlights the key findings from the study, focusing particularly on those factors which may be modifiable and therefore of potential value in the development of targeted interventions. The interpretation and application of the results are considered within a broader theoretical context, and implications for practice and future research are discussed.

20.2 Physical activity trends across the primary-secondary school transition

In line with previous studies, the data show significant gender differences in physical activity, with boys reporting greater participation in moderate and vigorous physical activity and higher levels of sports club membership than girls. The one exception was school sports clubs: around half of both girls and boys reported membership of sports clubs at school in P7, pointing to gender equality in sports participation within the primary school setting. However, this changes as children move into secondary school so that, by S2, almost twice as many boys than girls are members of sports clubs at school.

Age-related declines were evident across a range of physical activity outcomes, particularly among girls. Membership of a sports club, both in and outside of school, decreased among boys and girls between P7 and S2. However, overall physical activity levels remained stable among boys. This suggests that, although boys are opting out of organised activities during this transition period, they may compensate for this through increased recreational activities. In contrast, girls showed significant decreases in overall participation, indicating that girls are less likely to opt in to alternative forms of physical activity to take the place of organised sports provision.

In relation to physical activity behaviour, the move from primary to secondary school is clearly an important period of change. No school-level data were collected and therefore it is not possible to identify school variables which may explain these patterns. However, there are a number of plausible explanations. For example, there may be a lack of continuity of provision between primary and secondary schools such that pupils are unable to sustain participation in their usual or preferred activities. The increase in size of year group is likely to impact on opportunities to pursue sports and physical activities within organised clubs and teams. Changes in relationships with teachers and peers may also be important as children find themselves repositioned from oldest to youngest in the school, develop new friendship groups and form new identities. The primary to secondary school transition also coincides with the transition from childhood to adolescence, which is characterised by a period of significant biological change and psychosocial adaptation. The concurrence of developmental challenges with major socio-environmental change may increase the likelihood of disruption to young people's behavioural patterns.

20.3 Determinants of physical activity among early adolescent boys and girls

Psychological influences on adolescents' physical activity

Boys consistently had more favourable psychological profiles in relation to physical activity than girls. In P7 and S2, boys reported higher intention to be active, perceived sports competence, self-esteem and physical self-worth, and were more likely to report higher benefits of physical activity than barriers. By S2, boys also reported higher enjoyment of physical activity, higher exercise self-efficacy and were more likely to have a positive body image than girls. The fact that many of these gender differences were already apparent in P7 suggests the need for early intervention to support the development of a more positive self concept among girls, particularly in the physical domain.

Intention to be active is considered to be the proximal predictor of behaviour in many social cognitive models (Hagger *et al.*, 2001). Findings from the current study show that it is an important determinant of physical activity behaviour among early adolescents. Within the multivariate models, it was the only variable to remain significant for boys and girls at both time points. These results are similar to those of Godin *et al.* (2005) who found that intention was the most important determinant in a prospective study of regular exercise among boys and girls (mean age 13.3 years at baseline). Intention itself has been found to be influenced by a number of factors, including enjoyment and self-efficacy (e.g. Bungum *et al.*, 2000). Thus, it would appear that increasing intention to be active on a regular basis should be an important focus for intervention and may be achieved by promoting a sense of fun and building young people's confidence in their ability to take part in physical activity.

The results show a marked decline in enjoyment of physical activity among girls which occurs as they progress from primary to secondary school. At the end of primary school, both boys and girls show similarly high levels of enjoyment. While boys' enjoyment remains stable across the primary-secondary school transition, the sharp decrease among girls suggests that girls' attitudes towards physical activity may be particularly vulnerable during this transitional period. Strong cross-sectional associations exist between enjoyment and physical activity among both boys and girls supporting the view that enjoyment is an important correlate of physical activity among early adolescents. However, the findings indicate that its influence may vary by age. McCarthy *et al.* (2008) suggest that sources of enjoyment are subject to developmental progression among children and adolescents. Thus, longitudinal changes in reported enjoyment and in the association with physical activity behaviour may reflect more fundamental developmental processes affecting children's experiences of 'fun'. It is also likely that girls' attitudes towards physical activity are influenced by their feelings about themselves, their bodies and their physical capabilities. Indeed, perceptions of competence within the physical domain are thought to be central to intrinsic motivation. According to Harter (1981b), children who perceive themselves as competent and feel responsible for their successes and failures have higher levels of intrinsic motivation. Intrinsic motivation has been described as "*the motivation to do something for its own sake in the absence of extrinsic rewards and is related to feelings of mastery, control and self-determination*" (Biddle & Armstrong, 1992, p.325). It is considered essential for maintaining engagement in physical activity.

Perceived sports competence was found to be significantly correlated with physical activity among both boys and girls, showing that children who feel able to perform well within a sports context are more active. In univariate analysis, the strongest effect was in P7 boys among whom perceived competence accounted for almost a quarter of the variance in physical activity. While perceived competence may be central to performance enhancement, from a public health perspective a more important focus is that of personal development in relation to perceptions of one's own ability within the physical domain. If, at age 11 years, children already feel that they lack the physical skills required for physical activity and sport, it is not surprising that participation falls as they face the social and environmental changes associated with the transition to secondary school and cope with the concurrent developmental and psychological adaptations associated with puberty. This is likely to be a particular issue for girls, among whom levels of perceived competence were consistently lower than those of boys. Indeed, the fact that two-fifths of S2 girls cited lack of skill as a barrier to being active is of concern. Furthermore, from a feminist sociological perspective, some have argued that young women who lack confidence in their physical self become disempowered socially in a society where so much emphasis is placed on physical attributes:

"*Such is the strength and power of discourses around the body that the confidence with which a young woman engages with physical activity and physical education seems to be significantly influenced by the 'appropriateness' of her body as well as the fear of public display. If physical competence or capital is perceived to be wanting in any way, then the development of social capital is highly unlikely*" (Garrett, 2004, p.232).

There may, however, also be significant social consequences for boys with low perceived competence. According to Weiss (1991), athletic competence is strongly related to peer acceptance and popularity among boys. Thus, boys who hold low perceptions of their own sports competence may not only be at risk of physical inactivity, but may also face social isolation and peer group rejection within an adolescent male culture which holds sporting prowess and achievement in high esteem.

Linked to the concept of perceived competence is self efficacy, which relates to the confidence a person has in their ability to perform a certain behaviour in the face of internal or external challenges. Corbin (2002) argues that confidence and skill are closely connected; learning skills can help to build confidence in one's own ability, but confidence is required to develop skills. Thus, both are relevant to behaviour and need to be reinforced within learning contexts. Self-efficacy is also likely to be critical to the extent to which children are able to maintain an active lifestyle in the face of increasing internal and external pressures as they get older. The goal of promoting lifelong physical activity is dependent on enabling individuals to continue in physical activity participation despite changing circumstances and priorities. However, physical activity behaviour appears most vulnerable to negative change during major life transitions. Increasing an individual's self-efficacy may help to reduce the likelihood that they will drop out of physical activity when faced with significant life events or periods of stress.

There has been some debate about the potential overlap between self-efficacy and perceived behavioural control (PBC), which is a key construct within the Theory of Planned Behaviour. According to Hagger *et al.* (2001, p.712), perceived behavioural control "*reflects the person's assessment of their capacities (e.g. skills and abilities) and the limiting or facilitating factors (e.g. barriers and access to facilities) regarding behavioural engagement.*" Both constructs therefore relate to the degree of personal control perceived by an individual and, depending on their specific conceptualisation, may include both internal and external aspects of control. Early work by Susan Harter and colleagues demonstrated the importance of children's perceptions of control in determining achievement patterns (Fry, 2001). Distinctions have been made between the two constructs by conceptualising self-efficacy as relating to internal aspects of control (i.e. an individual's abilities) and PBC as relating to external aspects of control (i.e. external barriers) (e.g. Terry & O'Leary, 1995; Armitage & Conner, 1999). Indeed, in the current study, self-efficacy was conceptualised in this way, with items representing an individual's confidence in their own ability to do physical activity in the face of (internal) barriers. Perceived behavioural control was not included in this study due to a lack of appropriate measures and therefore it was not possible to compare their relative influence on behaviour. However, in a study of the influence of self-efficacy and PBC on intention to be active among early adolescents in England, Hagger *et al.* (2001) found that self-efficacy was a strong predictor of intentions and attenuated the effect of PBC on intentions.

Although Hagger and colleagues did not investigate associations with physical activity behaviour, their conclusions are in agreement with findings from the current study which suggest that high self-efficacy may be particularly important to physical activity behaviour among this age group. Self-efficacy was significantly associated with physical activity among all groups except for P7 girls. For these girls, their attitudes towards physical activity appeared to be more important. According to DiLorenzo *et al.* (1998, p.475), "*enhancing self-efficacy for exercise through exposure to a variety of physical activities in combination with external validation and support, appears pertinent to promoting continued physical activity among girls*". However, the results suggest that self-efficacy is less relevant for younger girls but becomes more important to the maintenance of physical activity participation as they get older.

In relation to physical activity behaviour, physical self-concept also appears to be important among the early adolescent age group. The findings from univariate analysis show that physical self worth was highly correlated with physical activity among both boys and girls and accounted for a similar proportion of the variance in P7 and S2, indicating consistency of effect during this transitional period. However, the effect of physical self worth did not remain significant within the multivariate model, suggesting that it is less important than other aspects of self-concept such as perceived competence and self-efficacy.

Irrespective of associations with physical activity, the finding that boys had higher self-esteem scores than girls, both on the global measure and for the domain-specific measure of physical self worth, is important as high self-esteem is associated with a range of positive outcomes. These include wellbeing, life satisfaction, academic achievement, positive perceptions by peers and enhanced coping skills (Biro *et al.*, 2006). On the other hand, low self-esteem has been associated with health-compromising behaviours, including unsafe sex, suicide ideation and eating disorders (Salazar *et al.*, 2005; Martin *et al.*, 2005; McGee & Williams, 2000). Thus, the findings suggest that, even by age 11, girls may be at greater risk of negative health outcomes as a result of poorer psychological status.

Contrary to expectation, body image and body satisfaction were not associated with physical activity in girls. High levels of body consciousness are known to be prevalent within the female population and are confirmed in the current study where only around a third of girls were happy with their body shape. Over half of girls in P7 and S2 said that they would like to be thinner. Self-consciousness, particularly in relation to the physical self, has previously been reported as a barrier to physical activity among adolescent girls (e.g. Mulvihill *et al.,* 2000). Accordingly, it was hypothesised that poor body image and low body satisfaction would be associated with lower levels of physical activity among girls. The lack of effect found in the current study could be explained by a lack of correspondence between body consciousness and actual body shape, if poor body image is a universal phenomenon affecting girls of varying body shapes and sizes. Alternatively, it may be that, in relation to physical activity, girls' perceptions of their body size are less important than confidence in their physical capabilities. Girls may be able to overcome feelings of body consciousness if they have the skills to perform well or if they are given opportunities to take part in activities in which they do not feel exposed or embarrassed. Another potential explanation for the lack of association is that girls who perceive themselves as too fat are using exercise as a weight loss mechanism and are therefore just as likely to engage in physical activity as those of normal weight.

A significant relationship was found among boys, but the findings are complex. Cross-sectional associations showed that boys who perceived themselves as too fat and wanted to be thinner were less active. Thus, current negative evaluations of the body appear to place boys at risk of inactivity, suggesting that these boys are an important group in terms of targeting interventions. In contrast, longitudinal analyses revealed that perceiving oneself as too thin in P7 was predictive of low physical activity in S2, and this effect remained significant after controlling for S2 body image and P7 physical activity. It is likely that this represents a maturational effect whereby late developing boys drop out of physical activity as their more developed peers gain a physical advantage. The relationship between puberty and physical activity is discussed in more detail later on in this chapter. However, in light of the increasing policy focus on promoting levels of physical activity among adolescent girls, these findings demonstrate the importance of ensuring that specific male subgroups who are at risk of disengagement are not overlooked.

Social influences on adolescents' physical activity

Social influences are central to social cognitive and ecological theories of health behaviours. A considerable body of research supports the importance of the family in establishing early behavioural patterns in children. Parents may influence their children's behaviour through a number of different mechanisms, including role modelling, parenting style, monitoring, transmission of norms and values, and social, emotional and practical support (Pedersen *et al.*, 2002). Results from the current study support the role of parents in relation to physical activity behaviour among early adolescents. Both mothers and fathers are important, but the findings suggest the relative influence of each varies according to the age and gender of the child. This is in agreement with other research which shows that social influences vary by developmental level (Sallis, 1994). When considered independently, both maternal and paternal support were associated with physical activity among boys and girls. However, multivariate analyses showed that maternal support was only significant among girls whereas paternal support was significant for both boys and girls.

In the integrative model for girls shown in Chapter 18, support from mothers was found to be significant in P7 but not in S2. As with other research, this suggests that parents tend to have a greater influence on younger children (Sallis, 1994) but that other influences outside the family become more important as children grow older. However, the opposite effect was found for boys, whereby paternal support was significant in S2 but not in P7. Thus, fathers may have a particularly important role in promoting physical activity among boys during the early secondary school years. There is some evidence from other studies to indicate that fathers have a more important role within sport socialisation processes than mothers do (e.g. Greendorfer & Lewko, 1978; Rossow & Rise, 1994). If this is the case, the fact that boys report higher levels of paternal support than girls is likely to be of relevance in relation to the gender inequalities in reported participation. It is probable that the influence of family members on children's physical activity is also affected by the quality of these relationships. One would expect the influence to be greater in families where relationships are strong and there is a sense of shared values. Indeed, research has shown the importance of factors such as family communication in relation to a range of health outcomes (e.g. Ackard *et al.*, 2006; Compan *et al.*, 2002; Young *et al.*, 1995).

It should be noted that the measure of social support included in this study provides a limited representation of the role of parents in promoting and supporting their children's physical activity. It includes items on encouragement, praise, transportation, observation and participation in joint activities. Thus, it covers emotional and practical aspects of support. However, other elements of the socialisation process, such as parental activity and familial norms and values, were not assessed. These may also be significant and might explain more of the variance in behaviour than was explained by the current model. Fishwick and Greendorfer (1987) state that the concept of norms may be particularly important in relation to female sport where socio-cultural norms tend more toward non-participation than participation. Furthermore, behavioural norms may themselves be subject to group differences, varying, for example, by ethnicity or social class, and these differences should be taken into consideration in any future study of the impact of social systems on individual behaviour.

In relation to the family, findings suggest that siblings also provide a potentially important source of social support for physical activity. Univariate analysis showed a significant relationship between sibling support and PA among both boys and girls. This effect disappeared within the multivariate model but it is possible that this may be due to the small numbers for whom data on sibling support were available, as around two-fifths of pupils reported that they did not have or did not see an older sibling. No difference was found in the amount of support from older siblings reported by boys and girls. This may indicate that the gender differentiation observed in parental socialisation does not exist between siblings. This remains a neglected area of research which is worthy of further attention.

Potential mechanisms through which the family may influence children's behaviour also include structural and material factors such as family composition and socioeconomic status. No evidence was found for a relationship between family structure and physical activity within the study sample. However, family structure was only measured in P7 and this may therefore warrant further investigation, particularly as findings from previous studies have proved inconclusive.

As discussed in Chapter 2, previous research has revealed mixed findings concerning the influence of socioeconomic status on children and young people's physical activity. In the current study, a significant, positive relationship was found, such that adolescents from more affluent families reported higher levels of physical activity. This was evident for both boys and girls in P7 and girls only in S2. These results concur with those from the HBSC study (Levin *et al.*, 2007), but differ from Scottish Health Survey data which suggest that children from lower socioeconomic groups are more active (Stamatakis, 2005). Conflicting findings may arise from the use of different SES indicators but may also reflect different types of physical activity being assessed. In general, evidence indicates that, while lower SES groups may take part in more (or at least as much) moderate physical activity as their more affluent peers, those from higher SES groups may be more likely to participate in organised sports. This is because organised sports tend to have greater resource requirements, such as membership fees, specialised equipment and the need for transportation to training and match facilities. All of these may act as barriers to participation among those from less wealthy families. In contrast, moderate physical activities, such as walking and cycling, require very little, if any, specialist equipment and can be done within the area in which children live. Indeed, families without access to a car are likely to be more reliant on walking and cycling for transportation. Although family affluence only accounted for a small proportion of the variance in total physical activity, it remained in the multivariate social model for P7 boys, thus suggesting a more important effect among this group. The only group for whom no significant effect of family affluence was found was S2 boys. Accordingly, there may be equalisation of physical activity behaviour across socio-economic groups as boys grow older, suggesting that physical activity has an important role within adolescent male culture, irrespective of material background, or that a greater diversity of sporting opportunity is available to older boys in Scotland.

The influence of peers on young people's behaviour increases as they progress through childhood into adolescence. Peer groups meet social and emotional needs for identity and acceptance, and also share norms, values and behaviours. The association between peer groups and health behaviour is complex and may function in different ways. For example, some evidence suggests that young people may change their behaviour to conform to group norms and gain acceptance within specific peer groups. Thus, initiation and maintenance of behaviours is explained by peer group pressure. An alternative theory is that adolescents seek out friends with similar interests and/or behaviours to their own and thus friendship groups are formed according to these shared interests. Consequently, peer group homogeneity may result from processes of selection into groups or conformity to existing members of a group (Turner *et al.*, 2006).

Peer influence on physical activity behaviour is often explored in the context of peer support. In the current study, a positive relationship was found between peer support and physical activity and, among S2 girls, peer support was the only social variable to remain significant within the multivariate model. Thus, having friends to provide encouragement and do activities with seems to be particularly important for these older girls. Overall, however, the findings suggest that levels of support may be less important than the amount of time that young people spend with their friends outside school. Time spent with friends can provide an indicator of the degree of influence of the peer group on the individual. From a cross-national perspective, adolescents in Scotland spend a much greater amount of time with their friends in the evenings than their peers from other European countries (Settertobulte & Gaspar de Matos, 2004a) and this has been associated with a range of health-damaging behaviours, including smoking and alcohol consumption (Settertobulte & Gaspar de Matos, 2004b). Results from the current study indicate that peer socialising is one of the strongest determinants of physical activity among early adolescents. This association was observed longitudinally; in both boys and girls, time spent with friends in P7 was predictive of S2 physical activity, even after controlling for peer socialising in S2. Previous research by Vilhjalmsson & Thorlindsson (1998) has also shown that sociable adolescents are more physically active. This is consistent with the notion that people participate in sports for the purpose of socialising with others, but also shows that time spent with one's friends is associated with health-enhancing, as well as health-damaging, behaviours within the adolescent population.

Social influences may be particularly important for adolescent girls at a time when many of the personal attributes of girls around puberty may conflict with the idea of an active lifestyle. For example, body image concerns, low self-esteem and concepts of femininity may act as psychological barriers to participation during this vulnerable stage of adolescent development. Encouragement from friends and parents may be important in helping to counter such negative self-perceptions and enable girls to sustain an interest in physical activity during the adolescent years. Girls are more likely to maintain an active lifestyle if physical activity is valued and prioritised within the family or peer group context. Indeed, Neumark-Sztainer and colleagues (2003) found that support for physical activity from peers, parents and teachers was one of strongest and most consistent predictors of physical activity among adolescent girls. They suggest that "*the effectiveness of interventions aimed at increasing physical activity among adolescent girls might be enhanced by engaging support from friends, family and caring adults*" (Neumark-Sztainer *et al.,* 2003, p.803). In relation to girls' socialisation into physical activity, Butcher (1983) found that socialising agents and situations were more influential than the personal attributes of the girls themselves. However, results from the current study show that social variables accounted for a greater proportion of the variance in physical activity among boys, suggesting that, among Scottish adolescents, social factors may be more relevant to boys' than girls' physical activity. This could be due to a greater focus on team sports for boys meaning that physical activity is more likely to take place within a social context. Alternatively, it may reflect the age of the young people included in this study, with socialisation processes perhaps being more important to girls during early childhood in order to establish behavioural norms and values which may be maintained over time and withstand external cultural threats as they get older.

Environmental influences on adolescents' physical activity

Environmental factors explained a smaller proportion of variance in physical activity behaviour compared with psychological and social factors. This may reflect conceptual limitations of the environmental items within the questionnaire. Research into environmental influences on young people's physical activity is still a relatively new field and this is reflected in the lack of validated tools available for use within this age group. Despite this, the availability of sports and games equipment within the home was associated with physical activity for boys and girls in both P7 and S2 and emerged as an important predictor of girls' physical activity. This suggests that availability of equipment is an important facilitator of physical activity in young people. The presence of sports and games equipment is likely to be an indicator of the degree to which physical activity is valued and supported within the home environment and, therefore, reflects wider socio-cultural norms within the family.

Some gender differences in perceptions of environmental supports were evident. For example, boys were more likely to report that facilities for sports and physical activity were available locally. This may reflect the fact that boys of this age have higher levels of independent mobility compared with girls (Hillman *et al.*, 1990). If boys have more freedom to roam, they may be more likely to be aware of the existence of local facilities and their definition of 'local' may also be broader, reflecting the more varied spaces and places to which they have access. Having facilities in one's local area, however, does not necessarily mean that these are easily accessible for use. It is possible to live very close to a park, but access may be restricted by physical barriers, such as busy roads, or by social barriers, such as the presence of people who may be considered threatening or unsafe.

From a policy perspective, there is renewed interest in the role of the environment in promoting health. Increased physical activity is thought to be an important pathway by which engagement with the physical environment may result in improved health outcomes. However, little is known about how children perceive and utilise the physical environment and how this may affect their behaviour and wellbeing. For example, some of the questions used in this study use the concept of 'neighbourhood', but children and adolescents may vary in their conceptualisation of what neighbourhood is. The fact that adolescents' perceptions of the local neighbourhood and neighbourhood safety were found not to be a significant predictor of physical activity behaviour may be because many children of this age take part in physical activity outside the area where they live, but may also reflect issues in conceptualisation and interpretation. Understanding the difference between boundaries of neighbourhood and the areas where physical activity takes place would provide greater insight into the influence of the local neighbourhood on physical activity behaviour.

Indeed, Giles-Corti *et al.* (2005b) have emphasised the need to measure context-specific behaviours, that is, those that occur within the physical area being assessed. It is probable that generalised measures of physical activity will not be sensitive to specific environmental attributes (Davison & Lawson 2006). Therefore, the lack of environmental effects observed in the current study may be a methodological artefact arising from the use of a generic physical activity outcome measure. Much of young people's physical activity may take place within the area where they live, for example, in local streets, gardens or parks. More structured, organised activities, such as community sports clubs, however, may well be located outside young people's immediate neighbourhood. Where activities take place outside the local area, participation is likely to be more dependent on financial resources and transportation than on characteristics of the physical environment.

Physical activity determinants: an integrative perspective

Findings from this study clearly show that determinants of physical activity behaviour operate at different levels, including intrapersonal, interpersonal and broader environmental spheres of influence, providing support for social ecological models of health and health behaviour. Psychological, social and environmental factors were all found to have an important role in determining physical activity behaviour among early adolescents in Scotland. The models presented in Chapter 18 varied by age and gender, showing the importance of taking the demographic characteristics of young people into account in the development of interventions. Psychological factors were most consistent in their effect across groups, including both self-perception and attitudinal variables. Intention to be active was the only variable which was significant for both boys and girls in P7 and S2.

The physical environment was less influential, with only home equipment (P7 boys and S2 girls) and availability of facilities (P7 girls) remaining in the model once psychological and social factors were accounted for. As previously discussed, this may partly be explained by methodological limitations. However, this finding concurs with that of Giles-Corti & Donovan (2002b) who investigated the relative influence of individual, social and physical environment determinants of physical activity in adults. Their findings suggest that environmental modification may enhance achievement of physical activity recommendations but, in the absence of strategies to enhance individual and social determinants, is not enough to increase participation.

Longitudinal analyses revealed similarities in the predictors of physical activity among boys and girls. For both genders, four P7 variables were found to be significant predictors of S2 physical activity, of which three were the same: intention, self-efficacy and peer socialising. Girls and boys who reported higher exercise self-efficacy and intention to be active and spent more time with their friends after school in P7 were more physically active in S2. This suggests that these factors should be a core focus for intervention in the upper primary years. As discussed earlier, body image was also significant for boys, with those who felt they were too thin in P7 being less active in S2. This was the only P7 variable for which the effect remained significant after controlling for previous physical activity, indicating an important independent effect. Among girls, the amount of sports and games equipment at home reported in P7 predicted S2 physical activity, but this effect disappeared after controlling for S2 home equipment.

Level of physical activity in P7 was found to be an important predictor of physical activity behaviour in S2 among both boys and girls. This concurs with much previous health behaviour research which has shown past behaviour to be the strongest predictor of present behaviour (e.g. West *et al.*, 2004; Conrad *et al.*, 1992), and highlights a need for early intervention to ensure that children are given maximal levels of support for being active from the very early years. Studies of adults suggest that past behaviour attenuates the influence of socio-cognitive variables on physical activity (e.g. Godin *et al.*, 1993). One explanation for this is that habitual participation results in reduced cognitive deliberation over future behaviour (Hagger *et al.*, 2001). Hagger and colleagues tested this theory in young people by investigating the influence of past behaviour on physical activity intentions. They found that controlling for past behaviour did not weaken the influence of attitudes, subjective norms, perceived behavioural control and self-efficacy on physical activity intentions, and concluded that "*past behavioural engagement does not have the same cognitive-reducing influences on young people's physical activity intentions* *that has been reported in adults*" (Hagger *et al.*, 2001, p.722). Instead, they suggest that situation-specific factors are highly relevant to the decisions young people make about physical activity participation. Similarly, results from the current study show that current intention to be active predicted physical activity among S2 boys and girls, irrespective of P7 physical activity levels. Furthermore, the effect of S2 self-efficacy also remained significant after controlling for P7 activity. This is in agreement with the findings of Hagger and colleagues, suggesting that a young person's intentions to be active, and their confidence in their own ability to be active despite internal or external barriers, are more likely to be explained by cognitive assessments which take place within their immediate context than past experience.

The use of multilevel modelling enables estimation of school level, as well as individual level, variation in physical activity to test whether differences in physical activity behaviour may be explained by differences between schools. The results of the multilevel analyses, however, showed that there were no school level effects in physical activity behaviour. Examining hierarchical associations across the primary-secondary school transition is particularly complex. Cluster effects were measured at the level of the secondary school, but it is possible that this masked potential differences between the participating primary schools. The number of secondary schools may also have been insufficient to identify significant school differences. Previous research has found school effects for a number of different health behaviours. For example, West and colleagues examined school effects on smoking, drinking, drug use and 'unhealthy' eating behaviour (West *et al.*, 2004). They found significant school effects for smoking, drinking and drug use but not for diet. Instead, school differences in diet were explained primarily by socio-economic variables such as social class and deprivation. This may be, in part, due to the fact that eating habits are established at an early age and consequently may be less susceptible to school level influences during the secondary school years. In contrast, experimentation with smoking, drinking and drug use typically begins during the early adolescent years and may therefore be more influenced by school level factors at this stage of life. In this respect, physical activity is more similar to diet, with patterns of behaviour developing from an early age. However, it is important to note that a lack of school level variance does not suggest that school-related factors have no influence over physical activity behaviour.

Overall, the models explained less than half of the variance in physical activity behaviour. There are several possible reasons for this. For those variables which were not significantly related to physical activity, it cannot be determined whether the latent constructs have no role in influencing children's physical activity, or whether their conceptualisation and measurement was inadequate to detect associations. For those variables which were significantly associated with physical activity, errors in the measurement of physical activity and / or determinants may have led to underestimation of observed associations. As mentioned earlier, Giles-Corti *et al.* (2005b) also highlight the need for increased specificity of ecological models to improve their predictive capacity and argue that future research should examine specific behaviours within specific contexts. In relation to physical activity behaviour, for example, there is a need to differentiate between determinants of school-based physical activity, recreational activity and active transportation. The use of a generic measure of physical activity in the current study may have led to underestimations of associations, particularly in relation to environmental correlates. There are also several potential spheres of influence which were not assessed in the current study which could account for some of the unexplained variance. These would include physiological, socio-cultural and economic factors, all of which provide areas for further investigation. However, the proportion of variance explained by the models in this study is similar to other studies of physical activity determinants among adolescents (e.g. Morgan *et al.*, 2003). The models explained a greater proportion of the variance for boys than for girls. This has also been found in previous research investigating psychosocial predictors of physical activity among adolescents (e.g. Welk *et al.*, 2003). Potential explanations for the observed gender differences are discussed in more detail later on in this chapter.

20.4 Proposed model of determinants of physical activity among early adolescents

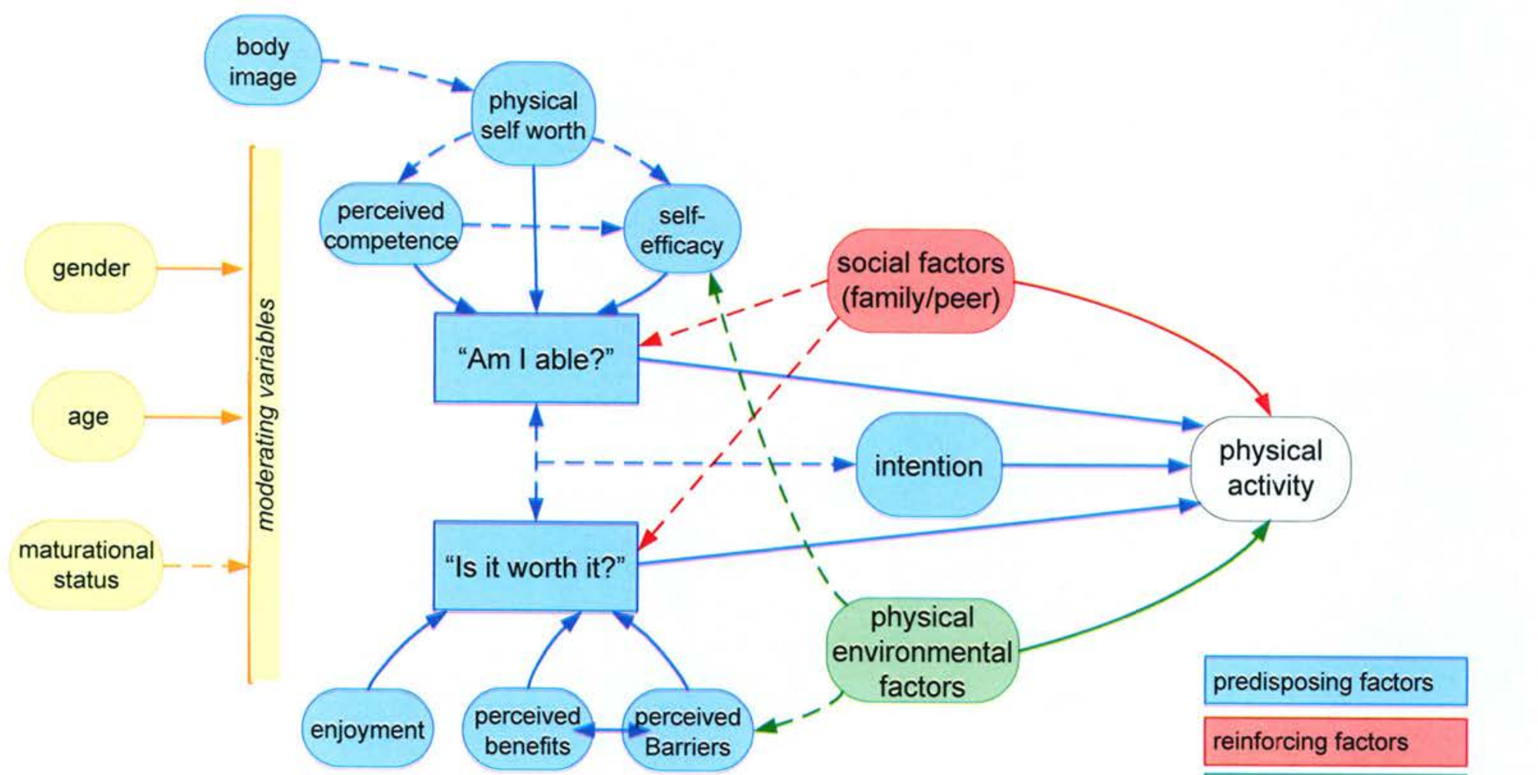
"To provide guidance for the design of effective programs, behavioural science models must be predictive of behaviour and indicate procedures that promote change in behaviour." (Baranowski *et al.*, 1998, p.266)

The results from this study are summarised in the proposed model of determinants of physical activity behaviour among early adolescents (Figure 20.1). This model elaborates on the Youth Physical Activity Promotion Model developed by Welk (1999). It provides a conceptual framework for understanding the influences of psychosocial and environmental factors on physical activity and highlights possible opportunities for intervention. Welk's model adopts a socio-ecological framework and draws on constructs from a range of behavioural theories. Its primary advantage is that it was developed to take account of specific developmental and cognitive characteristics of children. He argues that there are a number of important differences between adults and children which mean that one should not assume that existing models and theories can be applied directly to children and youth in the same way that they are in adults. Behavioural processes in children and adults are likely to differ from those in adults for a number of reasons, including:

- Lower capacity for informational processing (Thomas *et al.*, 1993)
- Lack of ability to distinguish between effort and ability as causes of achievement outcomes (Brustad, 1998)
- Stronger influence of parents and peers on children, especially in relation to values and beliefs.

Within health behaviour research, it is important not only to determine influencing factors, but also to identify specific mechanisms of action, particularly in relation to the development of appropriate interventions. Thus, there are several important questions to ask when identifying and interpreting relationships between variables. For example, is the relationship between independent and dependent variables direct, or are there other variables which may affect this relationship?

Figure 20.1: Model of determinants of physical activity behaviour among early adolescents



The present study investigated only direct effects of determinants on physical activity behaviour and, where these were found to be significant, they are represented by solid lines in the model. Additonal proposed pathways are indicated by dotted lines. These relationships were not explicitly examined but are hypothesised, based on existing theories and evidence. Future research should allow for investigation of these proposed pathways of influence.

Relationships may also vary for different subgroups of the population. Indeed, findings from the current study show that the strength of relationship between behavioural determinants and physical activity varies for boys and girls, and at different developmental stages. Thus, age and gender act as moderators within the model. A moderator has been defined as "*an interaction variable that affects the direction and/or strength of the relationship between an independent and dependent variable*" (Bauman *et al.*, 2002, p.14). Moderators are of interest from an intervention perspective because they provide information about when, or for whom, a variable most strongly predicts or causes an outcome (Kremers *et al.*, 2007), thus enabling programmes to be targeted to the needs of specific subgroups within the population (Bauman *et al.*, 2002). The importance of gender in relation to physical activity participation is discussed further later on in the chapter.

Within Welk's (1999) model, which draws on Green and Kreuter's Precede-Proceed model (Green & Kreuter, 1991) as an organisational framework, determinants are classified as factors that *predispose*, *reinforce* or *enable* physical activity behaviour. Predisposing factors are those which increase the likelihood that a person will be regularly physically active and consist of two distinct types of psychological constructs: self-evaluative and cognitive assessments. Based on earlier work by Fox (1991), Welk proposes that there are two fundamental questions which determine a young person's predisposition towards physical activity: 'Is it worth it?' and 'Am I able?' The first question relates to the assessment of perceived outcomes and includes both cognitive (e.g. cost-benefit analysis) and affective (e.g. enjoyment) elements. The second question relates to the self-evaluative component and addresses aspects of the physical self such as perceived competence, physical self worth and self-efficacy. Results from the current study provide support for these two components of the model by demonstrating significant associations between the relevant psychological constructs and physical activity behaviour among early adolescents. Furthermore, relationships within and between these two components are also likely to be influential. For example, physical self concept has been shown to be an important predictor of perceived competence and self-efficacy, as well as physical activity participation itself (Welk, 1999).

One of the limitations of Welk's original model is that no mention is made of intention to be active. Yet, intention was found to be an important predictor of physical activity in the current research, as well as in previous studies. Therefore, based on these findings, the model shown below assumes that intention is the immediate precursor of behaviour and mediates the relationship between predisposing factors and physical activity. These assumptions, however, need to be tested through further statistical analyses.

Reinforcing factors are conceptualised as intrapersonal factors which provide support for children's physical activity, primarily through the influence of family and peers. Other individuals, such as teachers or coaches, may also be significant in this respect but their influence was not examined in the current study and therefore they are not included here. Family members and friends may influence a young person's physical activity *directly,* through mechanisms such as practical support (e.g. provision of transport to sports facilities), encouragement and participation in joint activities. However, social influences may also have an *indirect* effect through a young person's attitudes and their perceptions of their own ability to take part in physical activity. In relation to self-perceptions, significant others can act as a key source of competency information, thereby reinforcing or undermining positive perceptions of self within the physical domain. Indeed, parental support has been found to have an indirect effect on youth physical activity through perceived sports competence (Biddle & Goudas, 1996) and self-efficacy (Trost *et al.*, 2003). The transmission of positive beliefs and attitudes is also known to be an important part of socialisation processes and therefore children's own attitudes and beliefs about physical activity may mediate the relationship between parental influence and physical activity. It is also likely that the effect of reinforcing factors is subject to developmental variation, as parental influence diminishes and peer influence increases with age. Although these indirect relationships were not specifically investigated in the current study, further research could be undertaken to test specific pathways of influence in more detail.

According to Welk (1999), enabling factors are considered to be necessary, but not sufficient, determinants of physical activity and include both biological and environmental influences. Results from the current study also suggest that physical environmental variables are of relevance to physical activity behaviour among early adolescents. It is likely that environmental factors have a direct effect by facilitating or hindering young people's opportunities to be active, but they may also moderate the effect of psychosocial factors on physical activity. For example, children who have the skills and motivation to take part in physical activity may not be able to do so if they do not have access to appropriate equipment or live too far away from appropriate places in which to be active. Recent work by Motl and colleagues (2007) provides support for an indirect effect of the physical environment on physical activity; among adolescent girls, they found that the relationship between equipment accessibility and physical activity was accounted for by exercise self-efficacy in relation to overcoming barriers. Thus, both direct and indirect pathways of influence are proposed in the model. Biological factors are not included as they were not investigated in the current study but may account for some of the unexplained variance in the models presented in earlier chapters. Relevant factors, including fitness, innate skills and body composition, are worthy of future investigation.

It is proposed that maturational status may also act as a moderator, particularly in relation to associations between psychosocial factors and physical activity. A few studies have found a significant relationship between maturational status and physical activity in girls and evidence that this is mediated by physical self-perceptions (e.g. Davison *et al.*, 2007). It is also possible that the effect is mediated by social factors, such as parental and peer influence, as a result of changes in the way significant others relate to a young person as they move from childhood into adolescence and become more physically mature. A small but significant effect of maturation on physical activity was found among girls in the current study, but only in relation to menarche. Menarcheal status was positively associated with MVPA, such that post-menarcheal girls were more likely to meet the current guideline. However, post-menarcheal girls were *less* likely to be a member of a sports club in or outside of school. These results indicate that, for girls, the relationship between maturational status and physical activity may differ according to type of physical activity.

The absence of more consistent associations was perhaps a reflection of methodological limitations rather than lack of importance of this factor. Only two single item indicators were included for girls, menarche and perceived relative physical development. These may not provide sufficiently robust or sensitive measures of the physical changes which are of social and behavioural significance among girls. The lack of effects could also be explained by a non-linear association between pubertal timing and perceived sports competence (Davison *et al.*, 2007) whereby perceived competence mediates the relationship between puberty and physical activity; early maturation may be perceived as an advantage for some sports, such as swimming, but a disadvantage for others, such as gymnastics.

The results also provided some evidence that puberty influences physical activity among males. Boys who considered themselves early developers relative to their peers were found to be more physically active, particularly in P7. By S2, some of these effects had disappeared, possibly due to decreasing differentiation in somatic indicators of maturation as boys get older. The fact that early maturation appears to be an advantage in terms of boys' physical activity was expected given that upper body muscle mass increases as boys mature. These findings are important, as they indicate that late developing boys may be at particular risk of low physical activity and may be an overlooked group in terms of physical activity interventions. Although they will catch up physically with their more developed peers as they get older, it may become harder to re-engage them in physical activity if involvement has already declined.

20.5 Explanations of gender differences in physical activity behaviour

The finding that different factors influence boys and girls differentially has important implications for practice in schools and other settings. Within the adolescent population, gender inequalities are of primary concern in relation to physical activity behaviour. Why girls are less active than boys remains a fundamental question to answer if these inequalities are to be effectively addressed.

There are several possible explanations for the observed differences in physical activity participation between boys and girls. Both socio-cultural factors (gender differences) and biological factors (sex differences) are likely to play a role. At a socio-cultural level, there is a considerable research literature highlighting differential attitudes and expectations in relation to the role of men and women within sport in the UK. In qualitative interviews with young people age 13-23 years, Coakley and White (1992) found that sporting prowess was associated with high status and peer acceptance among adolescent males whereas, in contrast, young women were more likely to see sport as irrelevant to their lives. According to Scraton (1987, p.176), "*sport is seen primarily as a male pursuit, bound up with masculine values. Young women spectate, support and admire: they do not expect to participate. Young women are immersed in a culture of femininity and romance, reinforced through the magazines they read, the television they watch and their every day experiences.*" Many sports, particularly those associated with physical contact, strength, speed and power, are more likely to be perceived as masculine (Corbin, 2002) and considered a more integral part of male culture. Thus, sports and vigorous activity are viewed as contrary to feminine ideals. Coakley & White (1992) report that many girls were reluctant to describe themselves as 'sportspersons' and felt that sport was more compatible with being a man than with being a woman. Such attitudes were often reinforced by school experiences in which boys were given more sporting opportunities than girls.

In Scotland, gender differences in physical activity levels have been observed among children as young as four years (Whitfield, 2000), which indicates a possible genetic influence and/or very early nurturing effects. Some have argued that there may be greater socialisation into sport among boys than girls, with socialisation agents being more likely to encourage and reward sports participation among boys (Vilhjalmsson & Thorlindsson, 1998). Welk *et al.* (2003) found higher levels of parental facilitation (provision of equipment, access and opportunities) among boys than girls. The types of physical activities which are available to young people within schools and the community are also of potential relevance to differential participation rates. Previous research has found that girls lacked confidence in physical activity when the task was perceived as masculine in nature, when there was a lack of feedback about performance, and when the task involved an evaluative element (Corbin, 2002).

From a biological perspective, changes in body composition during puberty may disadvantage girls in relation to physical activity participation. Increases in the proportion of body fat which are stimulated by rising oestrogen levels in early adolescent girls may make exercise more difficult (Rowland, 1999). During the adolescent growth spurt, body fat increases to around 25 per cent of body mass among girls, but declines to around 12-14 per cent of body mass among boys (Armstrong & McManus, 1996). Androgenic influences in males cause increases in muscle mass which enhances physical strength and athletic ability.

Recent research has raised the possibility that there may be gender differences in terms of energy expenditure requirements for boys and girls. Tudor-Locke *et al.* (2004) undertook a study to establish recommendations for pedometer-assessed steps per day related to healthy body composition. They analysed existing data from 1954 children aged 6-12 years across three different countries and determined a median optimal cut-point of 12,000 steps/day for girls and 15,000 steps/day for boys. These cut-points were based on the finding that girls taking fewer than 12,000 steps, and boys taking fewer than 15,000 steps, per day were more likely to be classified as overweight or obese. One explanation for this gender difference provided by the authors is that boys require additional steps per day to accommodate sex-related differences in energy intake. This suggests that boys may be required to do relatively more physical activity to attain the same health-related benefits as girls. If this it true, it would lend support to the idea of a biological control system for physical activity and would suggest that this functions differently in boys and girls. Further work investigating the relationship between levels of physical activity and specific health outcomes in children and adolescents may provide further insights.

From an evolutionary perspective, it is possible that, as girls reach reproductive maturity, there is a biological tendency towards energy conservation. Indeed, Goran *et al.* (1998) found a reduction in total energy expenditure among girls in the period just prior to onset of puberty which was explained by a 50% reduction in physical activity. They argue that this suggests the existence of an energy-conserving mechanism (through reduced physical activity) before puberty in girls. The sample size in this study was very small and therefore no firm conclusions can be drawn. However, their findings are in agreement with the theory that the age-related declines observed within the adolescent population are actually reflections of maturational, rather than chronological, age. The fact that the first sharp declines in physical activity typically coincide with the onset of puberty in girls could be suggestive of an underlying biological explanation, although it is difficult to disentangle the impact of biological processes from the physical and psychosocial changes taking place at this time.

20.6 Strengths and limitations of the study

This study has several important strengths as well as a number of limitations. The longitudinal design allowed for the examination of prospective, as well as cross-sectional, associations and, thus, the identification of predictors of physical activity behaviour. Another major strength was the interdisciplinary nature of the study, drawing on a range of theoretical perspectives to examine the interplay of psychosocial and environmental influences. Within the field of physical activity research, the need for integrative approaches that utilise common theoretical constructs has been acknowledged (Epstein, 1998). The research presented in this thesis has drawn on theoretical frameworks and empirical evidence from a range of disciplines, including behavioural science, sport and exercise psychology, developmental psychology, sociology of sport, environmental health and, to a lesser extent, biomedical sciences. In attempting to maximise on breadth of insight, however, it was necessary to compromise on depth of knowledge. It has not been possible to do justice to all the relevant literature or to include all the potential factors which may influence physical activity behaviour.

While seeking to provide an integrated model of physical activity behaviour, certain variables were excluded for practical (e.g. length of questionnaire) and analytical reasons (statistical / power limitations). It is acknowledged that some of these - for example, self-determination, perceived behavioural control and subjective norms - might have provided further useful insights into adolescents' behaviour. Their exclusion may have led to model misspecification as a result of omitted variable bias. However, all factors selected for inclusion in the study were based on established theoretical frameworks, a thorough review of the existing literature, and availability of valid measures. Items were developed or adapted for the study only when suitable measures could not be found, and these were then piloted to test appropriateness for use among early adolescents in Scotland.

Diez-Roux (1998) highlights the issue of 'methodological individualism', that is, the notion that the distribution of health within a population can be explained exclusively in terms of the characteristics of individuals. The social determinants literature has clearly shown the importance of group or macro-level variables in influencing health and health behaviours of individuals, both directly and by affecting the choices that individuals are able to make. In the current study, selection of variables was also informed by an ecological approach which highlights different levels of influence on individual behaviour. However, although socio-environmental variables were included, these were all self-reported. Therefore, the findings reflect determinants of behaviour at the individual level only. It could be argued that perceptions of the environment may be more relevant to behavioural patterns than objective measures.

For example, it is likely that an individual's perceptions of access to sports facilities would be more strongly related to use of those facilities than the actual distance from their home. However, further work should include measures of socio-environmental factors at the supra-individual level to clarify these relationships.

Strengths and limitations of quantitative methods

In this study, physical activity was measured using the Physical Activity Questionnaire for Older Children (PAQ-C). This instrument requires children to recall their activity undertaken during the previous seven days. It is acknowledged that children have more variation in their activity patterns than adults and, therefore, for some individual children, the previous week may not have been typical of their usual behaviour. Representations of habitual physical activity may also have been affected by temporary restrictive illness or disability at the time of data collection. However, the distribution of activity patterns should approximate to normality across the whole sample. The data were collected at the same time of year in each survey but, as the survey took place during late autumn / early winter, they may be subject to seasonal effects. Previous research has shown that children are less active during the winter months, particularly in regions where it can be very cold (Tucker & Gilliland, 2007). Therefore, it is possible that the levels of physical activity reported here are lower than they might have been if the data had been collected at other times of the year. However, the aim of the study was not to determine absolute levels of physical activity, but rather to investigate patterns and predictors of participation. There is no evidence to suggest that determinants of physical activity behaviour are subject to seasonal effects.

The limitations of self-reports relative to objective measures of physical activity have been discussed previously, particularly in relation to vulnerability to recall bias. Data obtained from children and adolescents may be influenced by decayed or competing memories, social desirability and misunderstanding of instructions (Sallis, 1991). Responses to questionnaire items may also be affected by developmental differences in cognitive capacities, as well as situational factors and personal characteristics.

However, lack of reliability of measures would increase the chances of failing to find differences or associations when they do actually exist (Anderssen *et al.*, 2006). Thus, the findings presented here are likely to be under- rather than over-estimated.

In relation to physical activity research, quantitative methods are valuable for measuring different dimensions of behaviour (e.g. type, frequency and duration), variations by subgroups (e.g. gender) and temporal change. However, it is also useful to recognise some of their limitations. When studying social phenomena, such as young people's behaviour, they are inadequate for providing information about the quality of experience or meaning of change. Qualitative methods are more useful for exploring personal experiences, beliefs, attitudes and motivations in-depth. In association with quantitative methods, they can be used to enhance understanding of factors that mediate behaviour, to help develop theories that can be used in research and interventions, and to better define items measuring mediating variables (Masse *et al.*, 2002). Wright *et al.* (2003) have highlighted a number of limitations of quantitative research designs in relation to understanding young people's participation in physical activity:

- Cannot provide information about the place and significance of physical activity in young people's lives and how these may change over time.
- Cannot demonstrate how young people deploy the discursive and material resources associated with physical culture to construct their identities in relation to physical activity.
- Provide few insights into the place of physical activity in relation to other forms of leisure in young people's lives.

Thus, further work in this area would benefit from the use of qualitative methods to explore in more depth individual experiences of physical activity during early adolescence. Indeed, evidence indicating a lack of effectiveness of physical activity interventions has led to calls for further basic behavioural research, including qualitative methods, to improve intervention development (Baranowski *et al.*, 1998; Masse *et al.*, 2002). As part of the larger PASS project, longitudinal qualitative data collection was undertaken and the findings from these will be used, along with the quantitative results, to make recommendations for physical activity promotion.

Missing data

Missing data are common in school-based studies involving large samples due to item non-response and absence on the day of data collection (Motl *et al.*, 2007). Furthermore, missing data are a particular issue in longitudinal studies as a result of loss to follow-up over time. In the current study, the main loss of cases occurred during the transition from primary to secondary school, when a considerable number of pupils who had taken part in the study in primary 7 moved to (unknown) non-participating secondary schools. However, comparison of P7 data from the longitudinal sample and the P7-only sample revealed that, for the majority of variables, there were no significant differences between the two groups. This indicates that bias associated with sample attrition is limited and unlikely to affect the results of the study.

It should be noted that differences in the base number of cases within the different models presented may account for some of the variability in the results. As a result of missing values on individual items, not all analyses were carried out on exactly the same group of children. In particular, multivariate and longitudinal analyses may be affected by a loss of power due to fewer cases being included in the models.

Issues in interpreting longitudinal data

The analysis of causality in behavioural research is complex. In most cases, there are multiple factors which may lead to changes in behaviour but causal pathways are not absolute – the presence or absence of known factors may increase the likelihood of a certain behavioural outcome but this is not guaranteed. In addition, there is also the potential for reciprocal relationships whereby the causal pathway may be bi-directional (Bauman *et al.*, 2002). Thus, in interpreting the findings from this study, it is important to make a distinction between association and causation. Causal pathways cannot be determined by observational studies but may be inferred based on other knowledge such as existing theory or previous research.

A number of criteria have been developed within the field of epidemiology to assess causality (Bauman *et al.*, 2002):

- Study design
- Strength of the association
- Temporal sequence
- Dose-response relationship
- Conceptual plausibility
- Biological plausibility

These criteria are derived from the original list of nine characteristics of scientific evidence developed by Bradford Hill (1965) to help establish causation rather than association. From an epidemiological perspective, the greatest weight is given to data from experimental studies with the randomised controlled trial being seen as the gold standard. Evidence from longitudinal cohort studies is seen as weaker than quasi-experimental studies but stronger than cross-sectional designs. In relation to strength of association, stronger statistical associations observed across a number of studies are seen as suggestive of a causal link. Consistency of effect across studies is also an important indicator. Temporality is central to causality such that the 'exposure' to the potential causal factors precedes the outcome. However, where reciprocal relationships exist, for example, within a social cognitive framework, temporality becomes less clear (Gee, 2008). Evidence of a dose-response relationship, whereby increasing levels of the independent variable are associated with corresponding increases in the dependent variable, is also suggestive of a causal relationship. Finally, the proposed causal relationship must be plausible. Bauman *et al.* (2002) refer to conceptual and biological plausibility but, within social science, psychosocial plausibility should also be considered important. In behavioural research this means using theoretical models or frameworks to examine how and why the presence or absence of a certain factor might influence behaviour, and identifying potential underlying biological or psychosocial processes which may explain the effect.

Although longitudinal research may provide strong indications of causal relationships, determining causality is problematic because of difficulties associated with measuring naturalistic changes in the variables of interest. Change over time can be examined in relation to *historical* or *developmental* effects. Historical effects are factors external to the individual that occur during the period of study and are represented by chronological time. Developmental effects are factors internal to the individual and typically represented by age. In some cases, both are of interest. Further *cohort* effects may arise from belonging to a particular group under study. For example, it may be that all children born in a certain year share specific characteristics (e.g. attitudes or behaviours) which make them more similar to each other than children born in other years – a so-called 'generational effect'. Similarly, it is not uncommon for school staff to recognise distinguishing features of particular year groups at the aggregate level. When considering the relationship between independent and dependent variables, causality is more likely when variation in physical activity has been produced by changes in the level or intensity of external influences such as exposure to an intervention (Bauman *et al.*, 2002). Thus, while observational studies can generate hypotheses about possible causal relationships and potential mediators, these would need to be tested subsequently using an experimental design.

Finally, it should be noted that only four local authorities (out of a total of 32) across Scotland took part in the PASS study and therefore the sample was not nationally representative. Rural schools were under-represented. However, the socio-demographic profile of the sample was similar to that of the national HBSC sample in terms of key indicators such as family structure and family affluence. The proportion of pupils entitled to free school meals was also similar to national figures. Thus, the findings are likely to be of relevance to the early adolescent age group across Scotland.

20.7 Implications for practice

"Strategies for improving wellbeing can be aimed at improving emotional, cognitive or motivational processes, increasing behavioural competencies, or altering the social conditions under which people live and work."
(Pajares, 2007, p.1)

Results from this study have important implications for the promotion of physical activity among early adolescents in Scotland. From a public health perspective, the primary goal is to increase levels of physical activity within the population in order to improve health outcomes and life expectancy. Changing people's behaviour, however, is not easy. Complex behaviours such as physical activity are particularly challenging because of the need to address multiple causal influences. Findings from the current study demonstrate that a wide range of personal, social and environmental factors are relevant to physical activity behaviour within the early adolescent age group. Efforts to promote physical activity must address these different levels of influence; if support for any one of these categories is missing, it may negate or at least reduce the impact of the others. For example, while having access to places to do physical activity may be important, children who feel they lack the skill to participate or lack friends with whom to participate, may be less likely to make use of available facilities. Indeed, evidence has shown that health promotion interventions are more likely to succeed when they take account of these complexities and employ integrated, multifaceted approaches (Nutbeam, 2000; Kahn *et al.*, 2002).

There is a need to move beyond disciplinary boundaries and develop an integrative approach to physical activity promotion. Research within fields such as environmental health has demonstrated the value of moving away from a reductionist, individualistic view of health towards interventions which are targeted at the level of society (Morris *et al.*, 2006). In light of the apparent inadequacy of individual-level interventions to produce sustained behaviour change (Hillsdon *et al.*, 2002), there is increased recognition of the need for population-level interventions which will require cooperation between a number of different sectors, including health, education, sport, transport and urban planning (Bauman & Craig, 2005).

However, there is also a need to focus on susceptible subgroups within society in order to ensure that health promotion initiatives have the potential for greatest impact, and do not exacerbate health inequalities due to greater take-up among more advantaged groups. Attempts to change behaviour at the individual level, for example, in relation to smoking and eating behaviour, have typically been more effective among higher socio-economic groups, leading to increasing inequalities (Baum & Harris, 2006). Thus, understanding the determinants of behaviour and specific barriers to physical activity participation among inactive or low active groups is essential to ensure that interventions can be targeted effectively.

It is clear that greater efforts are required to encourage girls to be more active and to feel better about themselves physically. In relation to observed gender differences in physical self perceptions, with boys reporting higher physical self worth, perceived competence and body satisfaction than girls, Fry (2001, p.75) comments: "*the manifestation of these gender differences should be of great concern to researchers in sport psychology and professionals working with children and adolescents in physical activity settings, as they hint that the stage may not be set for females to optimize their potential to the same extent that males do.*"

Within Scotland, three national programmes have been established specifically to promote and support physical activity participation among adolescent females. "Fit for Girls" is a joint collaboration between the Youth Sport Trust and Sportscotland which provides training and support to key stakeholders to facilitate the development of new ways of engaging girls and young women in physical activity within schools. Twenty-seven secondary schools across Scotland took part in the initial pilot programme between 2005 and 2007. Participating schools developed new activities for girls, such as dance, girls-only swimming and trampolining, as well as making improvements to changing facilities and PE kits. A new 3-year roll out targeting every secondary school in Scotland is being funded by the Scottish Government between 2008 and 2011.

Following on from the national Dance in Schools Initiative (2005-2008), further funding has been awarded to YDance to encourage teenage girls to get active through dance. A new three-year programme, 'Free to Dance', focuses on providing dance workshops outside of the school curriculum and strengthening pathways to local opportunities and provision. Use of dance as an expressive and non-competitive form of physical activity is seen as a valuable tool to engage girls who may be less interested in traditional sports. Within a community setting, the 'Girls on the Move' project supports projects which provide opportunities for young women to participate in sport and physical activity, and enable young women to gain the skills and experience needed to lead activities within their own communities. The project is funded by the Scottish Government in collaboration with The Robertson Trust and is delivered by Youth Scotland.

Girls and young woman are also a core focus of the Active Schools programme which was identified in 2003 as a key element of the Scottish Executive's drive to get more Scots more active. The programme is responsible for providing high quality opportunities for children to be active in and around the school day. It is supported by a network of 32 Active School Managers (one per local authority) and over 600 Active School Coordinators who are responsible for the planning and delivery of activities in both school and community settings. It incorporates a wide range of sport and physical activities into a comprehensive whole school approach.

Fundamental to each of these programmes is the need not only to provide more opportunities for physical activity, but also to support and enhance the psychosocial attributes which increase the likelihood that young people, and young girls in particular, will be physically active. Previous research and data from the current study highlight the need to focus on promoting enjoyment, confidence, skills and positive self-perceptions as well as providing a supportive physical and social environment. Without addressing these determinants of behaviour, it is unlikely that programmes intended to promote physical activity will achieve sustained behavioural change. Those involved in the delivery of such programmes must be aware of these factors and sensitive to the ways in which they influence how young people behave and feel about themselves, particularly within a performance context.

Recent policy documents have consistently highlighted the importance of schools as a setting for physical activity promotion among children and young people. In the present research, the absence of gender and socio-economic differences in school sports club participation among P7 children suggests that primary schools may be able to promote equalisation of opportunity across social groups. However, inequalities emerge in secondary school, reflecting the important changes in physical activity behaviour and the determinants of behaviour that occur during the period of transition. Despite this, Cale & Harris (2006) note a lack of evidence on the effectiveness of secondary school-based interventions. Thus, there is a critical need for further evaluative studies to investigate how engagement in physical activity can be effectively sustained across this transitional period and throughout the secondary school years. Although the focus of the current study was on determinants of leisure time physical activity, the findings have relevance for physical activity promotion within the school context, particularly in terms of identifying 'at-risk' subgroups within the early adolescent population and modifiable influences which may be targeted through developmentally-appropriate interventions.

While PE is seen as an important vehicle for achieving health-related physical activity outcomes, there is ongoing debate about its core aims and consequently a need for clarity in this area. Some have critiqued the increasing dominance of the health agenda within PE, particularly where this is being driven forward by concerns over rising levels of overweight and obesity. For example, Evans (2003) argues that, despite many uncertainties and ambiguities within the field of obesity research, the unquestioning acceptance of the notion of an 'obesity epidemic' has the potential to damage the educational interests and health of children and young people within the school setting: "*Health education, reduced to and driven by the unreflective rhetoric of the 'obesity discourse', is likely to presage curricula, teaching and learning in which success and achievement are defined not in terms of knowledge,* *understandings and competence but, rather, of body shape, size and weight.*" (Evans, 2003, p.98)

Similarly, Penney and Harris (2004, p.96) argue that *"embedded in policies and played out in current practices of physical education ('health and physical education') are incentives to pursue particular lives that are repeatedly being constructed as both healthy and desirable (for all) and that these lives presume the greater value and desirability of some bodies over others."*

Within Scotland, the positioning of PE under the banner of 'Health and Wellbeing' within the new curriculum may bring to the fore some of these tensions. While PE can clearly make an important contribution to health-related outcomes, those involved in the delivery of PE and other physical activity programmes must steer away from creating a focus on healthy *bodies,* which may become excluding and disempowering, and therefore inherently 'unhealthy'. Furthermore, Bouchard (1993a) highlights the importance of recognising the influence of non-modifiable factors on physical activity performance. For example, heredity plays a major role in the fitness of children and therefore some children will never achieve the same fitness goals as their peers, despite equal effort. Similarly, percentage body fat is also partly explained by genetic factors (Bouchard, 1993b). Thus, there is a need to avoid an over-emphasis on fitness or healthy weight, as these can be de-motivating and lead to negative consequences among young people themselves, such as reduced confidence. The promotion of motor skills is clearly central to the aims of PE but there is evidence to suggest that, currently, this is not being achieved successfully. Flintoff and Scraton (2001) found that feeling skilful was a valued part of physical activity involvement among adolescent girls, but that many girls felt that school PE failed to help them in the development of skills. Findings from the current study show that gender differences in physical self-perceptions are already evident in the upper primary years, thus reinforcing the need for early intervention and physical activity programmes to focus on promoting skill development and enhancing perceptions of competence among girls in particular.

The need for community-based interventions is also demonstrated by the results showing the importance of social and environmental factors in determining physical activity behaviour of early adolescents. The significance of the family in relation to young people's health and health behaviour has already been discussed. Findings from the current study, and evidence from previous research, suggest that parents have a critical role in influencing physical activity behaviour, both directly and indirectly. Thus, children who experience low levels of support from their parents and who are not exposed to positive socialisation processes from an early age are likely to be less physically active. There are also concerns over increasing parental restrictions on children's independent mobility. In the current study, the fact that the amount of time children spent with their friends after school in P7 was found to be a significant predictor of physical activity in S2, for both boys and girls, reflects the importance of children having the freedom to play independently with their friends.

In a review of physical activity interventions in youth, Stone *et al.* (1998) identified seven studies with a community-based intervention involving families. Among these, there was little evidence of significant behaviour change. A more recent review (van Sluijs *et al.*, 2007) identified four studies of family-based interventions among children (<12 years) and one among adolescents (≥12 years). The authors conclude that there is no evidence of an effect of family-based interventions among children and the findings among adolescents are inconclusive due to lack of studies. Further work is therefore required in this area. Findings from the current study suggest the need to focus on working with parents to enhance levels of emotional and practical support for their children, as well as developing physical activity opportunities within a peer group context. The findings that membership of community-based sports clubs was significantly higher among boys and children from more affluent families indicates that there are greater barriers to participation in such activities among girls and lower affluence groups. Thus, there is a need to provide appropriate and accessible recreational activities to meet the needs of girls and those from lower socio-economic groups.

Despite the wealth of evidence demonstrating a need to increase levels of physical activity within the adolescent population, some have criticised the current impetus to promote 'healthy lifestyles' and the focus on the child as a 'site' for intervention. It is claimed that this may exacerbate problems for children who are already struggling to live up to the ideals of 'beauty' as portrayed by the media and are now being bombarded by images of 'health', creating a new requirement for young people to evaluate and change their bodies in light of contemporary norms (Burrows & Wright, 2004). Wright *et al.* (2003) suggest that 'non-participation' in physical activity is too often interpreted as deficient or delinquent or falling short of an ideal and that such interpretations may typically be conferred upon girls and ethnic minority groups. They argue that "*this ideal is often framed in relation to healthy lifestyle and performance discourses which privilege middle-class, Anglo, male ways of doing leisure and physical activity*" (p.18).

It is clear that a participative approach is required which seeks to work *with* young people to establish reasons for disengagement and seek appropriate solutions. The notion of empowerment is central to the ideology of health promotion (Tones, 2005). Empowerment relates to the degree of control which individuals have over their lives and their ability to make choices about their life and health. Health promotion itself is seen as a process directed towards enabling people to exert control over the determinants of health and to take action to improve their health (Nutbeam, 1998). Thus, the core aim of physical activity promotion should be to enable young people to develop the skills and confidence which are required to live healthy and active lives. The findings from this study suggest that physical self perceptions, particularly perceived competence and self-efficacy, may be critical to maintaining physical activity levels during the early adolescent years, but that wider social and environmental factors have an essential role to play in reinforcing and enabling ongoing participation. From an intervention perspective, multi-component programmes which address these different levels of influence on behaviour and are implemented across a range of settings, including schools, families and communities, have the greatest potential for impact.

20.8 Opportunities for future research

The findings from this study highlight a number of possible areas for future research. The study represents a rich data source which lends itself to further analyses in many different ways. Firstly, it will be necessary to test the proposed model shown in Figure 20.1. Although this model is based on the findings from this study, some as yet untested pathways of influence are proposed. Structural equation modelling provides a useful technique to further examine the hypothesised relationships and pathways of influence between the latent constructs.

Findings from the study revealed that intention to be active was the most consistent determinant of physical activity behaviour across age and gender groups. In line with other studies, it is proposed that this may be the proximal determinant of physical activity, mediating the relationship between predisposing factors and physical activity behaviour. From an applied perspective, there is therefore value in understanding the factors which influence intention to be active as these may prove to be an important focus for intervention.

Among young adults, De Bourdeaudhuij *et al.* (2002) found that *changes* in psychosocial determinants were more successful in accounting for changes in physical activity behaviour over a seven-year period than psychosocial determinants at baseline. Thus, a pertinent question in relation to the current data is: Do *changes* over time in the independent variables predict *changes* in physical activity behaviour? Late childhood / early adolescence marks the first point at which major declines in physical activity occur. Identification of children whose participation decreases across the primary-secondary school transition, and comparison with those whose physical activity is maintained, would further illuminate key determinants and areas for intervention.

A key question arising from the findings concerns those factors which may account for the remaining proportion of the variance which is not explained by the variables examined in this study. Personal factors such as fitness and body composition may play a role and are worthy of further investigation. However, supra-individual factors, which were beyond the scope of the current study, are also likely to be important. For example, evidence from the HBSC study shows that, among 15 year olds in the Netherlands, there is no significant gender difference in the proportion meeting physical activity guidelines (Roberts *et al.*, 2004), suggesting that broader socio-cultural influences are relevant. In light of this, further empirical work is warranted to compare adolescents within Scotland with those from other countries where patterns of behaviour differ in order to examine cultural effects on physical activity behaviour at the country level.

As previously discussed, the results from this study show that having access to facilities and equipment is important for physical activity participation, but suggest that the physical environment alone may be insufficient to promote behaviour change among the early adolescent population. The role of environmental factors in relation to physical activity behaviour in children and adolescents is still a relatively new area of study but holds considerable potential for population level behaviour change. Further investigation of these relationships is therefore warranted to clarify associations and inform future interventions. From a methodological perspective, there is a need to develop valid and reliable measures of the physical environment and to enhance conceptual understanding of 'neighbourhood'. It is also important to disentangle the effects of subjective versus objective environmental influences and their associations with different types of physical activity behaviour. For example, the environmental determinants of walking behaviour, which requires no specialist equipment or facilities, are likely to be very different from those of more vigorous or structured sports activities. Furthermore, Pikora *et al.* (2003) propose the need for separate conceptual frameworks for environmental correlates of walking for transport and walking for recreation, arguing that these are distinct types of behaviour and therefore subject to different types of influence. While the current study has examined determinants of physical activity at a generic level, there may be important differences in determinants of different types of physical activity behaviour. Recreation is likely to be a more useful concept than transportation for exploring use of green space among young people, whereas street connectedness and the condition of pavements might be expected to be more relevant to transportation.

From an intervention perspective, experimental studies are needed to address definitively the determinants of physical activity behaviour among early adolescents. Findings presented in this thesis identify important determinants of behaviour but, as discussed previously, observational studies are limited in their ability to establish causality. Development and evaluation of interventions which target specific modifiable factors will enable causality to be determined and confirm their relevance within the early adolescent population in Scotland. Baranowski *et al.* (1998) argue for the need to better understand mediating variables through utilising a mediating variable framework in physical activity interventions. In this context, a mediator has been described as "an intervening psychosocial variable that is necessary to complete a cause-effect link between an intervention and physical activity" (Bauman *et al.*, 2002, p.13-14). Increased understanding of mediators in relation to physical activity will enhance the development of effective interventions. The mediating variable framework highlights the importance of theory in understanding physical activity interventions because the mediating mechanisms are the theoretically-derived variables used to design the intervention. It therefore allows for the identification of those components of an intervention which are effective and the mechanisms by which they influence behaviour. According to Baranowski *et al.* (1998), a mediating variable would account for the effect of an intervention if a positive relationship between the intervention and outcome became non-significant after statistically controlling for the mediator. Thus, while the overall aim of a physical activity intervention will be to increase physical activity behaviour, the focus of the intervention should be on those mediating variables which are understood, from a theoretical perspective, to effect behavioural change. As stated by Sallis and Owen (1999, p.132), "*interventions do not directly change behaviours. Interventions modify the factors that control behaviour, and those changes are expected to lead to improved behaviour.*"

Chapter 21

Conclusions

"Better to hunt in fields, for health unbought,
Than fee the doctor for a nauseous draught.
The wise, for cure, on exercise depend;
God never made his work for man to mend."
John Dryden (1631-1700)

This study investigated the influence of psychological, social and environmental factors on physical activity behaviour within a cohort of 1099 adolescents (aged 11-13 years). Although there have been many studies investigating correlates of physical activity behaviour among young people, the particular strengths of this study lie in its longitudinal design and integrative theoretical approach.

The results confirm findings from previous research, showing marked age and gender differences in physical activity participation. Self-reported physical activity was consistently higher among boys than girls. Age related declines during early adolescence were particularly evident among girls, and the transition from primary to secondary school clearly marks an important period of change. These trends have significant implications for the current and future health and wellbeing of young women in Scotland. Among boys, although membership of sports clubs decreased with age, overall levels of physical activity remained stable suggesting that recreational activities may compensate for the decrease in organised sports. For both sexes, physical activity participation in P7 was predictive of participation in S2, showing that early exposure to sports and physical activity increases the likelihood that young people will continue to be active as they get older.

Boys reported more favourable physical self perceptions than girls, with gender differences already apparent in Primary 7. Thus, within the physical domain, many

11-year-old girls are already at a disadvantage relative to their male peers. The findings also indicate that lack of confidence in one's own abilities is a major barrier to participation and should therefore be a key focus for intervention during the upper primary years. Surprisingly, body image was not found to be associated with physical activity among girls. This could be because poor body image is so prevalent within the female adolescent population and is not necessarily a reflection of actual body size. Alternatively, the lack of association between perceived overweight and physical activity may be explained by the use of exercise as a weight loss mechanism. Body image has been less well researched among adolescent males, but the findings from this study suggest that it may be a key influence on boys' physical activity behaviour. There is evidence that perceptions of overweight may inhibit participation among boys. However, longitudinal analyses revealed that perceptions of underweight in P7 predicted lower levels of physical activity in S2. It is possible that this may reflect a maturational effect whereby late maturing boys are more likely to drop out of physical activity compared with their more physically developed peers. The relationship between puberty, physical self-concept and physical activity among boys is worthy of further exploration.

Intention to be active was found to be the factor most consistently associated with physical activity. In line with established behavioural theories, it is proposed that this may be the proximal determinant of physical activity. Increasing intention to be active is therefore an important target for intervention. According to previous research, intention is itself influenced by factors such as enjoyment and confidence. Promoting positive physical activity experiences, with a focus on personal skill development rather than competition, is therefore most likely to be effective in enhancing intention.

From an integrative perspective, psychological factors appear to have the strongest effect among the adolescent age group and therefore remain an important focus for intervention. However, findings from the study show that social and environmental factors are also relevant and these are likely to have both a direct and indirect influence on physical activity behaviour. Family and peer group contexts are clearly important but need to be understood from a developmental perspective. For example, there is evidence that the influence of mothers is greatest among younger girls whereas the influence of fathers is greatest among older boys. The amount of time spent with friends is also a major influence on physical activity behaviour, particularly among boys. Among girls, the effect of peer socialising decreased and the effect of peer support increased with age, showing that, for older girls, having friends to be active with is more important than time spent with friends.

This study also makes a valuable contribution to the emerging evidence base around the relationship between environment characteristics and physical activity. The findings indicate that aspects of the physical environment, including sports facilities and equipment, can facilitate physical activity among early adolescents. From a policy perspective, there is renewed interest in the role of the environment in promoting physical activity because of the potential for wider health gains at a population level. Certainly, the findings reported here suggest this is an area which warrants further investigation among young people.

In summary, recognition of the different spheres of influence on adolescent behaviour points to the need for multifaceted approaches to physical activity promotion. The findings from this study provide empirical evidence to support the development of interventions within school, family and community settings in Scotland. Finding effective ways to engage girls in physical activities clearly remains a priority, although it is important not to overlook specific male subgroups who may also be at risk of inactivity. A developmental perspective is required which considers the needs and priorities of adolescents at different stages of development. The results highlight the primary-secondary school transition as a critical period for intervention but also support the need for earlier intervention, particularly in relation to the development of skills and competencies which may equip young people for lifelong participation.

Section 5

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Section 6

APPENDICES

Appendix 1

PASS Questionnaire

Physical Activity in Scottish Schoolchildren

HELLO!

Thank you for helping us with this survey.

This survey is part of a research project. By answering these questions, you will help us to understand more about physical activity among young people in Scotland.

Your answers will be looked at by the research team and no-one else. They will not be seen by your parents or teachers.

This is not a test - there are no right or wrong answers.

Please take your time to read each question carefully and answer it as honestly as you can.

When you have finished, please check over the questionnaire once more to make sure you have answered all the questions. Then put the questionnaire in the envelope provided and seal it.

How to answer the questions:

For most questions you will be asked to tick the box that best fits your answer. You should tick just one box for these questions.

For example:

How many pets do you have?

☐ None

☑ One

☐ Two

☐ More than two

Some questions give a list of statements down one side with a number of boxes for each statement. For these questions, you should tick one box on each line.

For example:

	strongly agree	agree	neither agree nor disagree	disagree	strongly disagree
I like it when it is sunny	☐	☑	☐	☐	☐
I like it when it rains	☐	☐	☐	☐	☑

If you find it difficult to choose just one answer, please think about what is true for you <u>most of the time</u>

Remember, this is not a test. There are no right or wrong answers.

YOU CAN NOW START ANSWERING THE QUESTIONS

SOME GENERAL QUESTIONS ABOUT YOURSELF

1 Are you a boy or a girl?

1 ☐ Boy

2 ☐ Girl

2 What month were you born?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	8 ☐	9 ☐	10 ☐	11 ☐	12 ☐
Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec

3 What year were you born?

☐	☐	☐	☐
1989	1990	1991	1992

4 Do you know the postcode for your home address?
If you do, tick 'yes' and write it down, if not tick 'no'

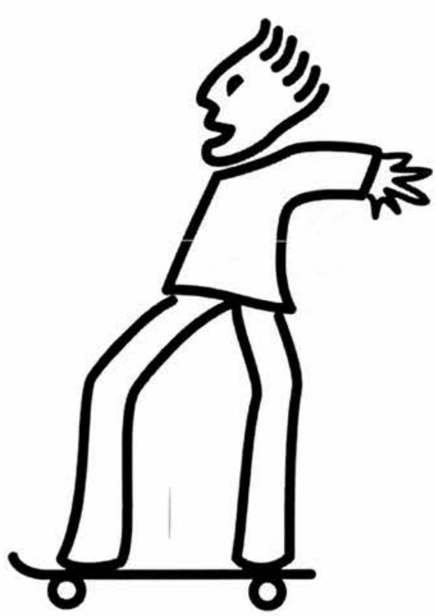
1 ☐ Yes, my postcode is ☐☐☐☐ ☐■■ ← **Note:** Do not write in the last 2 letters of your postcode

2 ☐ No

5 Are you:

Please tick all that apply

- ☐ Bangladeshi
- ☐ Black - African
- ☐ Black - Caribbean
- ☐ Black - other
- ☐ Chinese
- ☐ Indian
- ☐ Pakistani
- ☐ White
- ☐ Other (please say what) ....



PHYSICAL ACTIVITY

The next questions are about physical activity

Physical activity is ***any activity that makes your heart beat faster and makes you get out of breath some of the time.***

Physical activity can be done in sports, school activities, playing with friends or walking to school.

Some examples of physical activity are running, walking quickly, cycling, dancing, skateboarding, swimming, football, gymnastics.

6 How much do you enjoy doing physical activity?

- ☐1 A lot
- ☐2 A little
- ☐3 Not very much
- ☐4 Not at all

7 Do you have a disability or illness which prevents you from taking part in PE, games or sports?
Please tick one box

- ☐1 Yes, all of the time
- ☐2 Yes, most of the time
- ☐3 Yes, some of the time
- ☐4 No

If yes, please say what disability or illness...

8 **<u>During the last 7 days</u>, how often did you do physical activities in your free time?**

Read all FIVE statements before deciding on the one answer that best describes you

- 1 ☐ I never did physical activities in my free time
- 2 ☐ 1-2 times
- 3 ☐ 3-4 times
- 4 ☐ 5-6 times
- 5 ☐ 7 or more times

9 **<u>Last week</u>, on how many AFTERNOONS after school did you do sports, dance or play games in which you were very active?**

None	1 day	2-3 days	4 days	Every day
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

10 **<u>Last week</u>, on how many EVENINGS after school did you do sports, dance or play games in which you were very active?**

None	1 evening	2-3 evenings	4 evenings	Every evening
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

11 **THIS LAST WEEKEND, how many times did you play sports, dance or play games in which you were very active?**

None	1 time	2-3 times	4 times	5 or more times
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

12 **<u>During the last 7 days</u>, how often have you done the following sports or activities IN YOUR FREE TIME?**

Please tick one box for each line

	(1) 0 times	(2) 1-2 times	(3) 3-4 times	(4) 5-6 times	(5) 7 times or more
Cycling	☐	☐	☐	☐	☐
Football	☐	☐	☐	☐	☐
Roller blading or skateboarding	☐	☐	☐	☐	☐
Walking for exercise	☐	☐	☐	☐	☐
Jogging or running	☐	☐	☐	☐	☐
Swimming lengths or widths	☐	☐	☐	☐	☐
Gymnastics	☐	☐	☐	☐	☐
Active games (eg. chase, tig, skipping, rounders)	☐	☐	☐	☐	☐
Dance (eg. disco, ballet, tap)	☐	☐	☐	☐	☐
Basketball, netball or volleyball	☐	☐	☐	☐	☐
Tennis, badminton or squash	☐	☐	☐	☐	☐
Hockey	☐	☐	☐	☐	☐
Golf	☐	☐	☐	☐	☐
Karate, Judo or Tae Kwon Do	☐	☐	☐	☐	☐
Other, *please say what:*	☐	☐	☐	☐	☐

For these next two questions, add up all the time you spend in physical activity each day.

Remember: **physical activity** is any activity that makes your heart beat faster and makes you get out of breath some of the time.

13 Over the <u>past 7 days</u>, on how many days were you physically active for a total of at least <u>60 minutes</u> (1 hour) per day?

❑ 0 days ❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5 ❑ 6 ❑ 7 days

14 Over a <u>typical or usual week</u>, on how many days are you physically active for a total of at least <u>60 minutes</u> (1 hour) per day?

❑ 0 days ❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5 ❑ 6 ❑ 7 days

15 At the moment, on most days during my free time……
Please tick ONE box

1❑ I am sure I *will not* be physically active
2❑ I probably *will not* be physically active
3❑ I *may or may not* be physically active
4❑ I probably *will* be physically active
5❑ I am sure I *will* be physically active

16 How sure are you that you will be physically active during your free time in one year's time?
Please tick ONE box

1❑ I am sure I *will not* be physically active
2❑ I probably *will not* be physically active
3❑ I *may or may not* be physically active
4❑ I probably *will* be physically active
5❑ I am sure I *will* be physically active

17 Below are some sentences about exercise.

Exercise means any sport or physical activity that makes your heart beat faster and makes you get out of breath some of the time.

Please tick ONE box for each sentence to show how true it is for you

	(1) Very true	*(2)* Quite true	*(3)* Not very true	*(4)* Not at all true
I could exercise even if I was tired	❑	❑	❑	❑
I could exercise even if I had other things I wanted to do	❑	❑	❑	❑
I could exercise even if I had to exercise on my own	❑	❑	❑	❑
I could exercise even if I had a bad day at school	❑	❑	❑	❑
I could exercise even if I was feeling lazy	❑	❑	❑	❑
I could exercise even if I was not very good at it	❑	❑	❑	❑
I could exercise even if I was sore from exercising the day before	❑	❑	❑	❑
I could exercise even if I was not in the mood	❑	❑	❑	❑

18 Below are some reasons why some people do physical activity.

Please show how much each statement is true for you.
Please tick ONE box for each line

Physical activity.......	(1) Very true	(2) Quite true	(3) Not very true	(4) Not at all true
is fun	❑	❑	❑	❑
helps me cope with stress	❑	❑	❑	❑
helps me make new friends	❑	❑	❑	❑
gives me more energy	❑	❑	❑	❑
helps me keep in shape	❑	❑	❑	❑
makes me look better	❑	❑	❑	❑
helps me feel better about myself	❑	❑	❑	❑
makes me stronger	❑	❑	❑	❑
helps me be healthy	❑	❑	❑	❑

19 Below are some reasons why some people do not do physical activity. Please show how much each statement is true for you.
Please tick ONE box for each line

	(1) Very true	(2) Quite true	(3) Not very true	(4) Not at all true
I don't have enough time	❑	❑	❑	❑
It is difficult for me to get to places where I can do physical activities	❑	❑	❑	❑
I am not interested in physical activity	❑	❑	❑	❑
I would rather do other things with my time	❑	❑	❑	❑
I am not very good at physical activities	❑	❑	❑	❑
I don't have the right equipment	❑	❑	❑	❑
The weather is too bad	❑	❑	❑	❑
I feel embarrassed when I do physical activity	❑	❑	❑	❑
I have too much homework to do	❑	❑	❑	❑

20 **<u>OUTSIDE SCHOOL HOURS</u>: How OFTEN do you usually exercise in your free time so much that you get out of breath or sweat?**

- 1 ❑ Every day
- 2 ❑ 4 to 6 times a week
- 3 ❑ 2 to 3 times a week
- 4 ❑ Once a week
- 5 ❑ Once a month
- 6 ❑ Less than once a month
- 7 ❑ Never

21 **<u>OUTSIDE SCHOOL HOURS</u>: How many HOURS a week do you usually exercise in your free time so much that you get out of breath or sweat?**

- 1 ❑ None
- 2 ❑ About half an hour
- 3 ❑ About 1 hour
- 4 ❑ About 2 to 3 hours
- 5 ❑ About 4 to 6 hours
- 6 ❑ 7 hours or more

22 **Are you a member of any sports clubs <u>at school</u>?**

- 1 ❑ Yes
- 2 ❑ No

If yes, how many sports clubs are you a member of at school? ....

23 **Do you play for any sports teams <u>at school</u>?**

- 1 ❑ Yes
- 2 ❑ No

If yes, how many sports teams do you play for at school? ....

24 **Are you a member of any sports clubs <u>outside of school</u>?**

1 ☐ Yes

2 ☐ No

If yes, how many sports clubs are you a member of outside school? ....

25 **Do you play for any sports teams <u>outside of school</u>?**

1 ☐ Yes

2 ☐ No

If yes, how many sports teams do you play for outside of school? ....

26 **Below are some statements about you and physical activity.**

Please show how much each statement is true for you.

Please tick ONE box for each line

	(1) Very true	(2) Quite true	(3) Not very true	(4) Not at all true
I can run fast	☐	☐	☐	☐
I like to run and play hard	☐	☐	☐	☐
I enjoy sports and games	☐	☐	☐	☐
I have good muscles	☐	☐	☐	☐
I am good at sports	☐	☐	☐	☐
I can run a long way without stopping	☐	☐	☐	☐
I am a good athlete	☐	☐	☐	☐
I am good at throwing a ball	☐	☐	☐	☐

LEISURE ACTIVITIES

These next questions are about the things you do in your free time, outside of school

27 Here is a list of things that young people sometimes do in their free time when they aren't at school. What about you?
Please tick ONE box for each line to show how often you do these things.

	(1) Every day	(2) Most days a week	(3) A few days a week	(4) Once a week	(5) Less than once a week
Go to an after-school club	❑	❑	❑	❑	❑
Hang around with friends	❑	❑	❑	❑	❑
Watch TV	❑	❑	❑	❑	❑
Play computer games	❑	❑	❑	❑	❑
Email or chat with friends on a computer	❑	❑	❑	❑	❑
Talk to or text friends on the phone	❑	❑	❑	❑	❑
Listen to music	❑	❑	❑	❑	❑
Read books, comics or magazines	❑	❑	❑	❑	❑
Do household chores (eg. cleaning, cooking)	❑	❑	❑	❑	❑
Do a hobby, art or play a musical instrument	❑	❑	❑	❑	❑
Other, *please say what*:	❑	❑	❑	❑	❑

28 **About how many hours <u>a day</u> do you usually watch television (including videos) in your free time?**
Please tick one box for <u>weekdays</u> and one box for <u>weekend</u>

	Weekdays		Weekend
1 ☐	None at all	1 ☐	None at all
2 ☐	Less than an hour a day	2 ☐	Less than an hour a day
3 ☐	About 1 hour a day	3 ☐	About 1 hour a day
4 ☐	About 2 hours a day	4 ☐	About 2 hours a day
5 ☐	About 3 hours a day	5 ☐	About 3 hours a day
6 ☐	About 4 hours a day	6 ☐	About 4 hours a day
7 ☐	About 5 hours a day	7 ☐	About 5 hours a day
8 ☐	About 6 hours a day	8 ☐	About 6 hours a day
9 ☐	About 7 or more hours a day	9 ☐	About 7 or more hours a day

29 **About how many hours <u>a day</u> do you usually play on a games console (e.g. playstation, cube, Xbox) in your free time?**
Please tick one box for <u>weekdays</u> and one box for <u>weekend</u>

	Weekdays		Weekend
1 ☐	None at all	1 ☐	None at all
2 ☐	Less than an hour a day	2 ☐	Less than an hour a day
3 ☐	About 1 hour a day	3 ☐	About 1 hour a day
4 ☐	About 2 hours a day	4 ☐	About 2 hours a day
5 ☐	About 3 hours a day	5 ☐	About 3 hours a day
6 ☐	About 4 hours a day	6 ☐	About 4 hours a day
7 ☐	About 5 hours a day	7 ☐	About 5 hours a day
8 ☐	About 6 hours a day	8 ☐	About 6 hours a day
9 ☐	About 7 or more hours a day	9 ☐	About 7 or more hours a day

30 About how many hours <u>a day</u> do you usually use a computer (for playing games, emailing, chatting or surfing the internet) in your free time?

Please tick one box for <u>weekdays</u> and one box for <u>weekend</u>

Weekdays		Weekend	
1 ☐	None at all	1 ☐	None at all
2 ☐	Less than an hour a day	2 ☐	Less than an hour a day
3 ☐	About 1 hour a day	3 ☐	About 1 hour a day
4 ☐	About 2 hours a day	4 ☐	About 2 hours a day
5 ☐	About 3 hours a day	5 ☐	About 3 hours a day
6 ☐	About 4 hours a day	6 ☐	About 4 hours a day
7 ☐	About 5 hours a day	7 ☐	About 5 hours a day
8 ☐	About 6 hours a day	8 ☐	About 6 hours a day
9 ☐	About 7 or more hours a day	9 ☐	About 7 or more hours a day

31 About how many hours <u>a week</u> do you usually spend doing homework out of school hours?

Please tick one box

1 ☐ None at all

2 ☐ About half an hour a week

3 ☐ About 1 hour a week

4 ☐ About 2 hours a week

5 ☐ About 3 hours a week

6 ☐ About 4 hours a week

7 ☐ About 5 hours a week

8 ☐ About 6 hours a week

9 ☐ About 7 or more hours a week

The following questions are about your physical development

Physical development means ways in which your body changes as you grow older

32 Would you say that you have had a rapid growth in height (faster than usual) sometimes known as a "growth spurt" ?

- ☐ 1 Yes
- ☐ 2 No
- ☐ 3 Don't know

GIRLS ONLY:

(Boys go straight to question 34)

33 GIRLS: Have you begun to menstruate (have periods)?

- ☐ 1 No, I have not yet begun to menstruate
- ☐ 2 Yes, I began at the age of:

☐☐ years ☐☐ months

EVERYONE ANSWER NOW:

34 Do you think your physical development is any earlier or later than most other boys/girls your age?

- ☐ 1 Much earlier
- ☐ 2 Somewhat earlier
- ☐ 3 About the same
- ☐ 4 Somewhat later
- ☐ 5 Much later

35 How much do you weigh without clothes?
(Answer either in kilogrammes OR stones and pounds)

I weigh......................................kilogrammes

OR

I weigh........................stone ....pounds

OR

I don't know what I weigh ☐[0]

36 How tall are you without shoes?
(Answer either in metres and centimetres OR feet and inches)

I am.....................metre.....................centimetres tall

OR

I am.....................feet....................inches tall

OR

I don't know how tall I am ☐[0]

The following questions are about how you feel about yourself

37 Do you think your body is.....?

- [1] ☐ Much too thin
- [2] ☐ A bit too thin
- [3] ☐ About the right size
- [4] ☐ A bit too fat
- [5] ☐ Much too fat

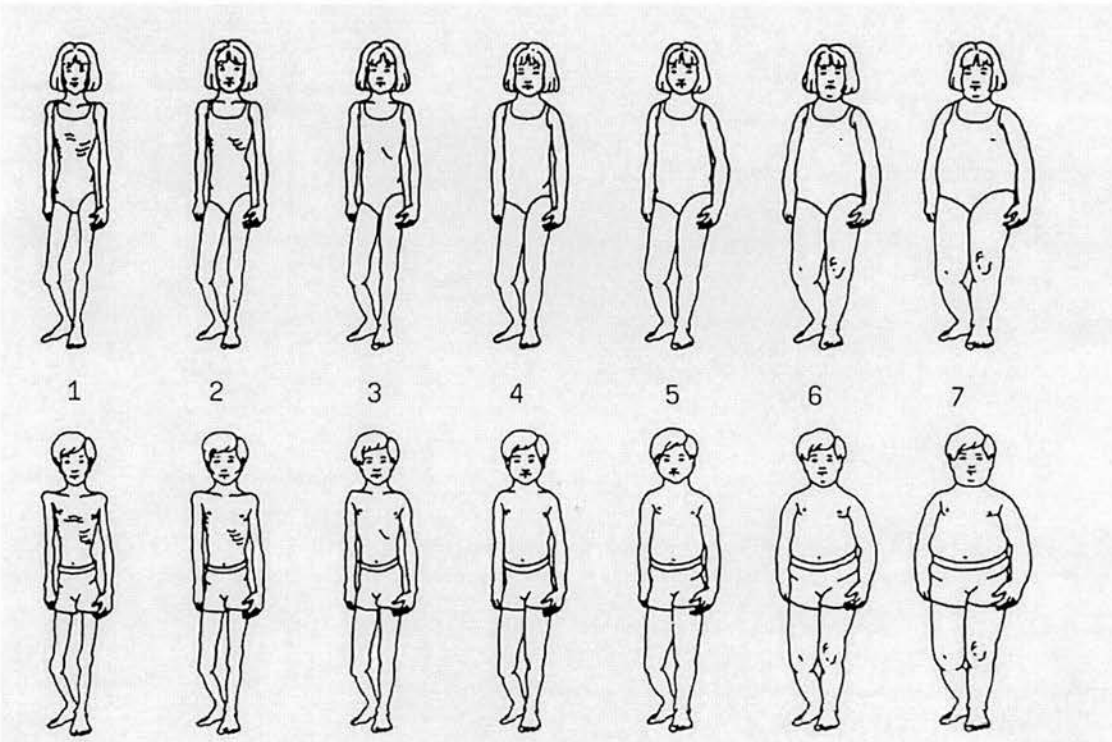
38 **These statements are about how you see yourself.**
Think about what is true for you <u>most of the time</u>.
Please tick ONE box for each statement to show how much you agree

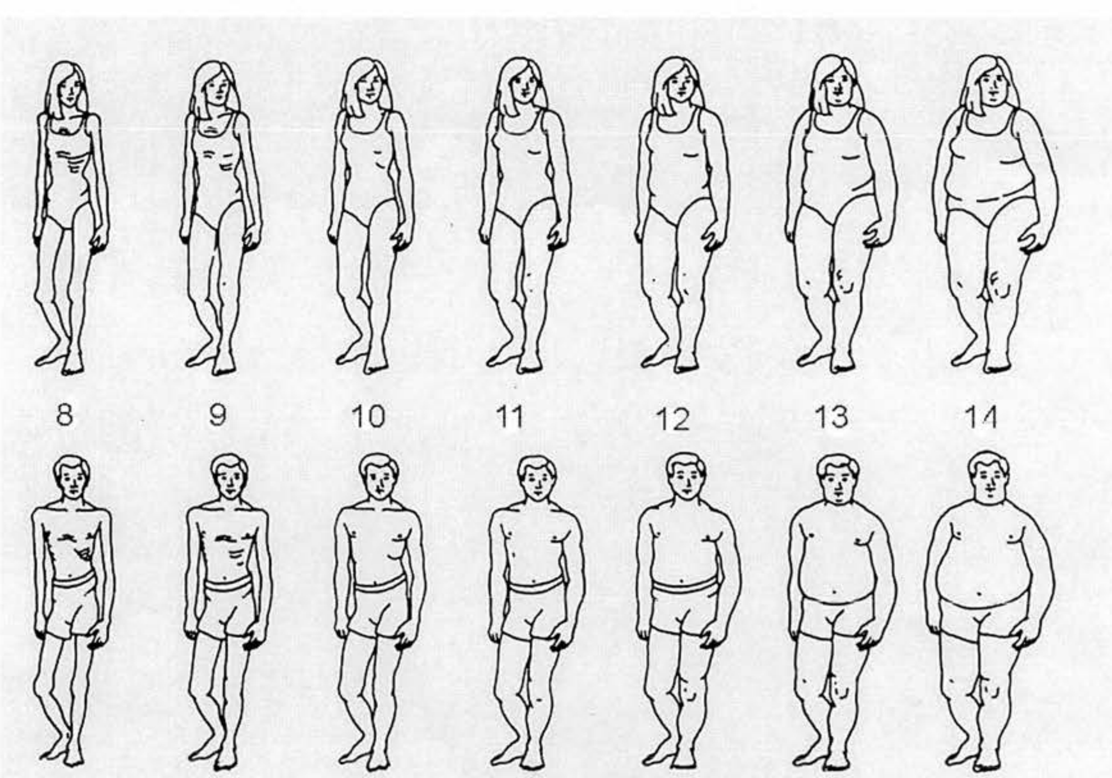
	(1) Agree a lot	(2) Agree a bit	(3) Disagree a bit	(4) Disagree a lot
I am pretty sure of myself	❑	❑	❑	❑
I often wish I was somebody else	❑	❑	❑	❑
I am easy to like	❑	❑	❑	❑
I have a low opinion of myself	❑	❑	❑	❑
I am a failure	❑	❑	❑	❑
There are a lot of things about myself that I would like to change	❑	❑	❑	❑
I am able to do things well	❑	❑	❑	❑
Most of the time I am satisfied with myself	❑	❑	❑	❑
I like myself	❑	❑	❑	❑
I feel I have a number of good qualities	❑	❑	❑	❑

Please look at the drawings of different body shapes below. Each drawing has a number - please put the number of the drawing that you think best answers the questions.

39 Which figure looks most like yours? ....

40 Which figure would you like to look like? ....





41 **Below are some statements about how you see yourself physically.**

Think about what is true for you <u>most of the time</u>.

Please tick ONE box for each statement to show how true it is for you.

	(1) Very true	(2) Quite true	(3) Not very true	(4) Not at all true
I am happy with how I am and what I can do physically	❑	❑	❑	❑
I feel confident about myself physically	❑	❑	❑	❑
I don't have much to be proud of physically	❑	❑	❑	❑
I feel positive about myself physically	❑	❑	❑	❑
I wish I could feel better about myself physically	❑	❑	❑	❑
I am very satisfied with myself physically	❑	❑	❑	❑

LIFE AT SCHOOL

42 **Here are some statements about your school.** Please tick ONE box on each line to show how much you agree or disagree with each one.

	(1) Agree a lot	*(2)* Agree a bit	*(3)* Neither agree nor disagree	*(4)* Disagree a bit	*(5)* Disagree a lot
Our school is a nice place to be	❑	❑	❑	❑	❑
I feel I belong at this school	❑	❑	❑	❑	❑
I feel safe at this school	❑	❑	❑	❑	❑
Other pupils accept me as I am	❑	❑	❑	❑	❑
My teachers are interested in me as a person	❑	❑	❑	❑	❑
The pupils in my class enjoy being together	❑	❑	❑	❑	❑
Our teachers treat us fairly	❑	❑	❑	❑	❑

43 **Are you entitled to free school meals?**

1❑ Yes

2❑ No

44 **On a typical day, is the MAIN part of your journey <u>to</u> school made by…..?**

Please tick ONE box

- ❑ 1 Walking
- ❑ 2 Car
- ❑ 3 Bicycle
- ❑ 4 Bus or train
- ❑ 5 Other, *please say what* ……………………………………………………………………

45 **On a typical day, is the MAIN part of your journey <u>from</u> school made by…..?**

Please tick ONE box

- ❑ 1 Walking
- ❑ 2 Car
- ❑ 3 Bicycle
- ❑ 4 Bus or train
- ❑ 5 Other, *please say what* ……………………………………………………………………

46 **How many days <u>last week</u> did you walk or cycle to or from school?**

None	1 day	2-3 days	4 days	5 days
1 ❑	2 ❑	3 ❑	4 ❑	5 ❑

47 **<u>Last week</u>, what did you do most of the time DURING MORNING BREAK TIME at school?**

Please tick ONE box

- ❑ 1 Sat down (talking, reading, doing schoolwork)
- ❑ 2 Stood around
- ❑ 3 Walked around a little
- ❑ 4 Ran around and played quite a bit
- ❑ 5 Ran and played hard most of the time

48 **<u>Last week</u>, what did you normally do AT LUNCHTIME at school (besides eating lunch)?**
Please tick ONE box

- [1] ☐ Sat down (talking, reading, doing schoolwork)
- [2] ☐ Stood around
- [3] ☐ Walked around a little
- [4] ☐ Ran around and played quite a bit
- [5] ☐ Ran and played hard most of the time

49 **How many classes or periods of PE do you have at school each week?**
NOTE: a double period counts as two.

☐	☐	☐	☐	☐	☐	☐	☐
0	1	2	3	4	5	6	More than 6 periods of PE

50 **During your PE classes <u>last week</u>, how often were you very active (playing hard, running, jumping, throwing)?**

I don't do PE	Hardly ever	Sometimes	Often	Always
1 ☐	2 ☐	3 ☐	4 ☐	5 ☐

51 **How much do you enjoy PE classes at school?**

- [1] ☐ A lot
- [2] ☐ A little
- [3] ☐ Not very much
- [4] ☐ Not at all

52 **How many days a week do you usually take part in extra-curricular (outside of class time) sports or physical activities at school?**

☐	☐	☐	☐	☐	☐	☐
0 days	1	2	3	4	5	More than 5 days

53 Below are some statements about what makes you feel most successful in sport.

Please tick one box for <u>each</u> statement to show how much you agree with it.

I FEEL MOST SUCCESSFUL IN SPORT…….	(1) Agree a lot	(2) Agree a bit	(3) Neither agree nor disagree	(4) Disagree a bit	(5) Disagree a lot
when I work really hard	❑	❑	❑	❑	❑
when others can't do as well as me	❑	❑	❑	❑	❑
when something I learn makes me want to go and practice more	❑	❑	❑	❑	❑
when I do better than my friends	❑	❑	❑	❑	❑
when I'm the best	❑	❑	❑	❑	❑
when I do my very best	❑	❑	❑	❑	❑
when I learn a new skill and it makes me want to practice more	❑	❑	❑	❑	❑
when I learn a new skill by trying hard	❑	❑	❑	❑	❑
when others make mistakes and I don't	❑	❑	❑	❑	❑
when a skill I learn feels really right	❑	❑	❑	❑	❑
when I'm the only one who can do something	❑	❑	❑	❑	❑
when I score the most	❑	❑	❑	❑	❑
when I learn something that is fun to do	❑	❑	❑	❑	❑

54 Do you have the following sports facilities or equipment at your school?

Please tick all that apply

- ❑ Swimming pool
- ❑ Tennis courts
- ❑ Games hall
- ❑ Sports field (eg. football, rugby, hockey pitch)
- ❑ Basketball or netball court or hoops
- ❑ Playground games / markings
- ❑ Bicycle racks or safe storage for bikes
- ❑ Changing rooms for PE
- ❑ Shower facilities
- ❑ Other, *please say what:* ....

The following questions are about you and your friends

55 How many days a week do you usually spend time with friends <u>after school</u>?

0 days	1	2	3	4	5 days
❑	❑	❑	❑	❑	❑

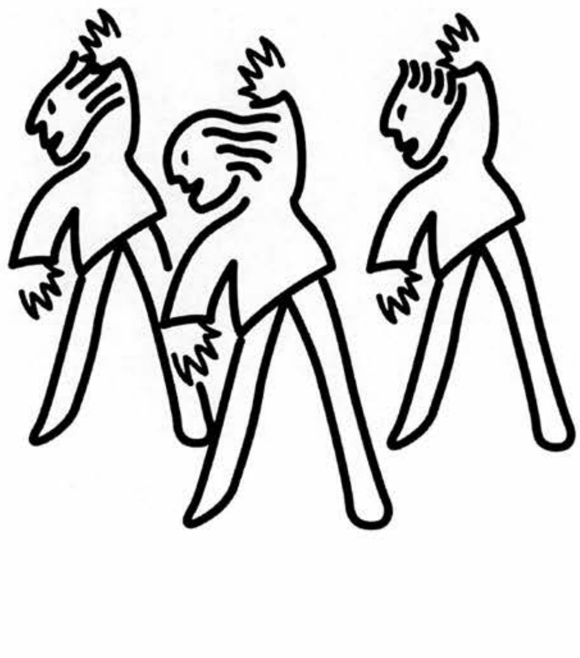
56 How many <u>evenings</u> during the school week do you usually spend time with friends?

0 evenings	1	2	3	4	5 evenings
❑	❑	❑	❑	❑	❑

57 How much do your friends do these things?

Please tick ONE box for each line

	(1) A lot	(2) A little	(3) Not very much	(4) Not at all
Encourage you to do sports or physical activities	❑	❑	❑	❑
Do sports or physical activities with you	❑	❑	❑	❑
Do sports or physical activities without you	❑	❑	❑	❑



These next questions are about your family and where you live

58 This question is about the people that you live with.

Not everyone lives with both their parents. Sometimes people live with just one parent or with someone else. Sometimes they have two homes or two families.

Please fill in column A for your main or your only home.

Fill in column B if you have a second home (<u>not</u> including holiday homes).

Column A

YOUR MAIN HOME

Please tick all the people who live here:

- ☐ Mother
- ☐ Father
- ☐ Stepmother (or father's girlfriend)
- ☐ Stepfather (or mother's boyfriend)
- ☐ Brother(s)
- ☐ Sister(s)
- ☐ Grandmother
- ☐ Grandfather
- ☐ I live in a foster or children's home
- ☐ Someone or somewhere else
  please write it here:
  ....

Do you stay here............?

- 1 ☐ All of the time
- 2 ☐ Most of the time
- 3 ☐ Half the time

Column B

YOUR SECOND HOME

Please tick all the people who live here:

- ☐ Mother
- ☐ Father
- ☐ Stepmother (or father's girlfriend)
- ☐ Stepfather (or mother's boyfriend)
- ☐ Brother(s)
- ☐ Sister(s)
- ☐ Grandmother
- ☐ Grandfather
- ☐ I live in a foster or children's home
- ☐ Someone or somewhere else
  please write it here:
  ....

Do you stay here............?

- 1 ☐ Half the time
- 2 ☐ Regularly but less than half the time
- 3 ☐ Sometimes
- 4 ☐ Hardly ever

59 **Does your family own a car, van or truck?**

- 1 ☐ No
- 2 ☐ Yes, one
- 3 ☐ Yes, two or more

60 **During the past 12 months, how many times did you travel away on holiday with your family?**

- 1 ☐ Not at all
- 2 ☐ Once
- 3 ☐ Twice
- 4 ☐ More than twice

61 **Do you have your own bedroom for yourself?**

- 1 ☐ No
- 2 ☐ Yes

62 **How many computers does your family own?**

- 1 ☐ None
- 2 ☐ One
- 3 ☐ Two
- 4 ☐ More than two

63 Do you have the following pieces of sports and games equipment at home?

Please tick all that you have

- ❑ Bicycle
- ❑ Balls (e.g. football)
- ❑ Racquets (e.g. tennis, squash, badminton)
- ❑ Roller blades, roller skates or ice skates
- ❑ Skateboard
- ❑ Skis or snowboard
- ❑ Weights
- ❑ Other, *please say what:* ....

These next few questions are about members of your family.

Remember: physical activity is any activity that increases your heart rate and makes you get out of breath some of the time. It includes sports, games, dance and play activities.

64 How important is it to the adults in your household that you do physical activity regularly?

Please tick ONE box for each line

	(1) Very important	*(2)* Quite important	*(3)* Neither important nor unimportant	*(4)* Not very important	*(5)* Not at all important	*(6)* Don't have or don't see
Male adult(s)	❑	❑	❑	❑	❑	❑
Female adult(s)	❑	❑	❑	❑	❑	❑

65 How important is it to the adults in your household that you are good at physical activity?
Please tick ONE box for each line

	(1) Very important	(2) Quite important	(3) Neither important nor unimportant	(4) Not very important	(5) Not at all important	(6) Don't have or don't see
Male adult(s)	❑	❑	❑	❑	❑	❑
Female adult(s)	❑	❑	❑	❑	❑	❑

66 How much does your MOTHER do these things?
Please tick ONE box for each line

0❑ Don't have or don't see mother (go to question 67)

	(1) A lot	(2) A little	(3) Not very much	(4) Not at all
Encourage you to do physical activities	❑	❑	❑	❑
Do physical activities with you	❑	❑	❑	❑
Do physical activities without you	❑	❑	❑	❑
Provide transport to a place where you can do physical activity	❑	❑	❑	❑
Watch you do physical activity	❑	❑	❑	❑
Praise you for doing physical activity	❑	❑	❑	❑

67 How much does your FATHER do these things?
Please tick ONE box for each line

☐ [0] Don't have or don't see father (go to question 68)

	(1) A lot	(2) A little	(3) Not very much	(4) Not at all
Encourage you to do physical activities	☐	☐	☐	☐
Do physical activities with you	☐	☐	☐	☐
Do physical activities without you	☐	☐	☐	☐
Provide transport to a place where you can do physical activity	☐	☐	☐	☐
Watch you do physical activity	☐	☐	☐	☐
Praise you for doing physical activity	☐	☐	☐	☐

68 How much does your OLDER BROTHER or OLDER SISTER do these things? *Please tick ONE box for each line.*

☐ [0] Don't have or don't see older brother or older sister (go to question 69)

	(1) A lot	(2) A little	(3) Not very much	(4) Not at all
Encourage you to do physical activities	☐	☐	☐	☐
Do physical activities with you	☐	☐	☐	☐
Do physical activities without you	☐	☐	☐	☐
Provide transport to a place where you can do physical activity	☐	☐	☐	☐
Watch you do physical activity	☐	☐	☐	☐
Praise you for doing physical activity	☐	☐	☐	☐

The following questions are about the area where you live

69 In the area where you live, are there….?
Please tick ONE box for each statement

	(1) Lots	(2) Some	(3) None
Groups of young people who cause trouble	❑	❑	❑
Groups of adults who cause trouble	❑	❑	❑
Litter, broken glass or rubbish lying around	❑	❑	❑
Run-down houses or buildings	❑	❑	❑

70 How much do you agree with the following statements?
Please tick one box for each statement

	(1) Agree a lot	(2) Agree a bit	(3) Neither agree nor disagree	(4) Disagree a bit	(5) Disagree a lot
It is safe to walk or cycle alone during the day in the area where I live	❑	❑	❑	❑	❑
It is difficult to walk or cycle in the area where I live because of things like traffic, no pavements, dogs, gangs etc	❑	❑	❑	❑	❑

71 How often are you allowed to play out in the local streets or park without an adult?

1❑ Whenever I want to

2❑ Only at certain times

3❑ Never

72 **Do you have the following facilities in the area where you live?**
Please tick ONE box for each line

	(1) Yes	(2) No	(3) Don't Know
Sports centre	❑	❑	❑
Playing field (e.g. football pitch)	❑	❑	❑
Swimming pool	❑	❑	❑
Park	❑	❑	❑
Basketball court or hoops	❑	❑	❑
Tennis court	❑	❑	❑
Ice rink	❑	❑	❑

73 **How easy is it for you to get to the following facilities?**
Please tick one box for each line

	(1) Very easy	(2) Quite easy	(3) Not very easy	(4) Not at all easy	(5) Don't Know
Sports centre	❑	❑	❑	❑	❑
Playing field (e.g. football pitch)	❑	❑	❑	❑	❑
Swimming pool	❑	❑	❑	❑	❑
Park	❑	❑	❑	❑	❑
Basketball court or hoops	❑	❑	❑	❑	❑
Tennis court	❑	❑	❑	❑	❑
Ice rink	❑	❑	❑	❑	❑

74 **For this research project, we would like to find out a bit more about what people your age think about physical activity.**

Would you be willing for us to talk to you and a friend about this?

1 ☐ Yes

2 ☐ No

THANK YOU FOR YOUR HELP WITH THIS SURVEY!

When you have finished filling in this questionnaire, please check through once more to make sure you have answered all the questions.

Then place the questionnaire in the envelope provided.

Appendix 2

Information sheets and consent forms

Administration guidelines for class teachers

Class response form

Physical Activity in Scottish Schoolchildren

PUPIL INFORMATION SHEET

What is PASS?

PASS is a new 3-year research project taking place in schools across Scotland to investigate physical activity and health among Scottish schoolchildren.

PASS is being carried out by researchers at Edinburgh University.

What's it got to do with me?

Your school has been selected to take part in the project. All P7 pupils in your school will be asked to complete a questionnaire. The questionnaire will be given out during class time and will include some questions about yourself, the types of physical activity and sport that you do and what you think about physical activity and health.

A small number of pupils may be asked to take part in an interview with one of the researchers in order to talk about physical activity in more detail. This is to help us understand better what you think.

Both the questionnaire and interview will be repeated when you move to secondary school, in the 1st and 2nd years.

Confidentiality

Everything you tell us will be treated confidentially. Your answers will only be seen by the research team. No parents or teachers will see what you have written. No names of individuals will be identified in any reports produced from the project.

Use of results

The results will help us to have a better understanding of physical activity among Scottish schoolchildren. Results will be written up in reports which we hope will be of interest to young people, teachers, parents and other researchers, and may be used to develop physical activity programmes for young people in the future.

Consent

Information will only be collected from those people who agree to take part in the project. Please sign the Consent Form to show that you are happy to take part in this project.

PASS

Physical Activity in Scottish Schoolchildren

PUPIL CONSENT FORM

- I have received and understood the information sheet about the PASS project.
- I understand that all the answers I give will be confidential and will be written up so that no-one will be able to identify me.
- I understand that the findings of the project will be written up in reports and may be published in research journals.
- I am happy to take part in this study.

NAME: (please print) ....

SCHOOL: ....

CLASS: ....

Signature: ....

Date: ....

P7 Parental Information Sheet

Physical Activity in Scottish Schoolchildren

PARENTAL INFORMATION SHEET

What is PASS?

PASS is a new 3-year study taking place in a number of schools across Scotland to investigate physical activity among Scottish schoolchildren. Previous research has shown that there are many benefits to being active, but that levels of physical activity among young people in Scotland are low. The PASS project aims to understand more about Scottish children's attitudes to physical activity, particularly as they move from primary to secondary school. Four local authorities in Scotland have been selected to participate in the study and the research will take place within a number of schools in each participating local authority area.

Who is conducting the study?

PASS is funded by the Health Education Board for Scotland. The research is being carried out by Dr Candace Currie and Jo Inchley at the Child & Adolescent Health Research Unit at Edinburgh University. Should you require any further information, please contact Jo on 0131 651 6269 or by writing to the address given in the attached letter.

What will this mean for your son / daughter?

The first stage of PASS involves the completion of questionnaires by P7 pupils in all participating schools. The school that your child attends has been selected to take part in this study and agreement has been obtained from the Head Teacher. In order to obtain an accurate picture

of pupil's physical activity, we need to collect information from as many pupils as possible so we hope that every pupil in P7 will be willing to complete a questionnaire. The questionnaire will be completed during class time and will include questions on physical activity behaviour and attitudes and some of the factors which are thought to influence physical activity.
A small number of pupils will then be invited to participate in an interview at a later date with the researcher in order to explore the issues in more depth.

Both the questionnaire survey and interviews will be repeated over three years in order to investigate changes in attitudes and behaviour during the transition from primary to secondary school.

Consent

The study has received the support of the Head Teacher of your child's school, the Local Authority Education Department and from Edinburgh University Faculty of Education Ethics Committee.

Any parent(s) or legal guardian(s) who wishes to withdraw his/her child from the study can do so by completing the Parental Consent Form and returning it to the school.

Confidentiality

All information collected through the project will be treated confidentially. Although we will require a record of names in order to repeat the survey over the three years, these will only be seen by the research team. No names of individuals will be released to any other organisation, nor will they be identified in any reports or publications arising from the study.

Use of results

We intend that the main findings from this research will be fed back to participating schools and local authorities and will be published in the form of reports and academic journals. The findings will be used by the Health Education Board for Scotland to inform policy and practice in relation to promoting physical activity among young people in Scotland.

PARENTAL CONSENT FORM

ONLY TO BE COMPLETED BY A PARENT OR GUARDIAN WHO WISHES TO WITHDRAW THEIR CHILD FROM THE PASS STUDY

This form is accompanied by an information sheet for you to keep.

Only complete this form **IF YOU ARE UNWILLING** for your child to take part in the study as described in the letter and information sheet.

If you do not complete and return the form, this will be taken to mean that you are WILLING for your child to take part.

(PLEASE USE BLOCK CAPITALS)

I, [*insert your name*] ____

BEING THE [*insert your relationship to the child e.g. mother, father, guardian*]
____________________________________ ________________________

OF [*insert child's full name*] ______________________________________

A PUPIL IN [*insert class or form*] ___________________________________

OF [*insert name of school*] ____

I WISH TO WITHDRAW MY CHILD FROM THE PHYSICAL ACTIVITY IN SCOTTISH SCHOOLCHILDREN (PASS) STUDY.

SIGNATURE: ______________________________ **DATE:** ____________

Please return this form to your child's class teacher or the main school office.

Administration guidelines for teachers

INFORMATION FOR CLASS TEACHERS

- Thank you for helping with the PASS study. PASS is a study of physical activity in young people and is being undertaken in eight school clusters across Scotland.

- This study is now in its third year and all S2 pupils in participating schools are being given a questionnaire to fill in. Most of the pupils in your class will have completed a questionnaire in one of the previous years and therefore should be familiar with what is required.

- Each pupil should be given the envelope with their name on the front. Each envelope contains a questionnaire (with personal ID number) and a blank envelope for returning completed questionnaires.

- Pupils who have not taken part in the study in previous years (marked with a red dot on the envelope) have also been given an information sheet and consent form in their envelopes. They should sign the consent form if they are happy to take part in the study and return it with their questionnaire.

- Please allow plenty time for completion of questionnaires. They should take no longer than 40 minutes to complete.

- If possible, please ensure that all desks are separated and that pupils are seated a reasonable distance apart to ensure confidentiality of responses.

- Pupils will need a pen or pencil. They may also wish to have a rubber and ruler to hand.

- Pupils should be reassured that <u>this is not a test</u>! Please encourage them to take their time and answer all questions carefully and honestly.

- Please complete the Class Response Form (attached) and return with all completed and uncompleted questionnaires.

- Spare questionnaires can be found in the envelope marked "SPARES". These may be used for any pupils who have joined the class since the original class list was sent. If these are used, please also give pupils an information sheet and consent form to sign and ask them to return these with the questionnaire.

CLASS RESPONSE FORM

To be completed by the class teacher

1. School name: ______________________________

2. Class name: ______________________________

3. Date of survey: ______________________________

5. Name of teacher: ______________________________

6 . No. pupils normally in class: __________

7. No. questionnaires completed: __________

8. Reasons for non-completion: *(please write the number of pupils on each line)*

   Illness ______

   Authorised absence ______

   Unauthorised absence ______

   Exclusion ______

   Pupil non-consent ______

   Parent non-consent ______

   Other ______

Appendix 3

Correlations between PAQ-C scale items

Correlation Matrix for PAQ-C scale (9 items): P7 longitudinal sample n=1099

	PA last 7 days	PA during afternoon	PA during evenings	PA last weekend	sport activities	active travel days	activity during breaktime	activity during lunchtime	active during PE
PA last 7 days	1.000	.476	.435	.415	.434	.031	.203	.179	.207
PA during afternoons	.455	1.000	.570	.531	.491	.043	.192	.226	.143
PA during evenings	.433	.570	1.000	.464	.452	.064	.112	.122	.137
PA last weekend	.418	.531	.464	1.000	.464	.048	.169	.194	.123
sport activities	.434	.491	.452	.464	1.000	.088	.179	.154	.188
active travel days	.033	.043	.064	.048	.088	1.000	.032	-.006	.070
activity during breaktimes	.195	.192	.112	.169	.179	.032	1.000	.525	.136
activity during lunchtimes	.188	.226	.122	.194	.154	-.006	.525	1.000	.090
active during PE	.182	.143	.137	.123	.188	.070	.136	.090	1.000

Correlation Matrix for PAQ-C scale (9 items): S2 longitudinal sample n=1099

	PA last 7 days	PA during afternoon	PA during evenings	PA last weekend	sport activities	active travel days	activity during breaktime	activity during lunchtime	active during PE
PA last 7 days	1.000	.550	.575	.529	.459	.008	.183	.207	.307
PA during afternoons	.550	1.000	.614	.571	.458	.021	.128	.197	.242
PA during evenings	.575	.614	1.000	.582	.465	.010	.122	.150	.268
PA last weekend	.529	.571	.582	1.000	.523	.018	.167	.212	.245
sport activities	.459	.458	.465	.523	1.000	.095	.133	.155	.223
active travel days	.008	.021	.010	.018	.095	1.000	-.068	-.020	.058
activity during breaktimes	.183	.128	.122	.167	.133	-.068	1.000	.512	.070
activity during lunchtimes	.207	.197	.150	.212	.155	-.020	.512	1.000	.161
active during PE	.307	.242	.268	.245	.223	.058	.070	.161	1.000

Appendix 4

Scale properties: principal component analysis

Physical Activity Questionnaire for Older Children (PAQ-C)

Table A4.1: Factor loading for principal components analysis: PAQ-C (short form) among P7 pupils

	P7 boys (n=458)	P7 girls (n=525)	P7 all (n=983)
PA during free time in last 7 days	.63	.78	.72
PA during afternoons last week	.82	.79	.81
PA during evenings last week	.77	.78	.78
PA during last weekend	.74	.77	.76
Participation in individual activities	.72	.75	.74
Eigenvalue	2.73	3.01	2.90
% variance	54.68	60.14	58.08

Table A4.2: Factor loading for principal components analysis: PAQ-C (short form) among S2 pupils

	S2 boys (n=497)	S2 girls (n=550)	S2 all (n=1047)
PA during free time in last 7 days	.78	.77	.80
PA during afternoons last week	.80	.80	.82
PA during evenings last week	.79	.83	.82
PA during last weekend	.81	80	.82
Participation in individual activities	.71	.71	.72
Eigenvalue	3.04	3.08	3.17
% variance	60.88	61.54	63.43

Perceived benefits

Table A4.3: Factor loading for principal components analysis: PERCEIVED BENEFITS items among P7 pupils

Physical activity....	P7 boys (n=500)		P7 girls (n=546)		P7 all (n=1046)
	Factor1	Factor2	Factor1	Factor2	
Is fun	.52	-.11	.53	.54	.53
Helps me cope with stress	.54	.55	.51	.28	.53
Helps me make new friends	.52	.46	.47	.64	.50
Gives me more energy	.59	-.02	.67	-.04	.64
Helps me keep in shape	.65	-.42	.70	-.28	.68
Makes me look better	.59	.11	.67	-.22	.63
Helps me feel better about myself	.58	.34	.69	-.10	.64
Makes me stronger	.69	-.24	.71	-.28	.71
Helps me be healthy	.68	-.43	.68	-.13	.67
Eigenvalue	3.25	1.06	3.59	1.03	3.43
% variance	36.06	11.80	39.90	11.41	38.16

Table A4.4: Factor loading for principal components analysis: PERCEIVED BENEFITS items among S2 pupils

Physical activity....	S2 boys (n=522)		S2 girls (n=556)		S2 all (n=1078)	
	Factor1	Factor2	Factor1	Factor2	Factor1	Factor2
Is fun	.57	.17	.57	.41	.59	.31
Helps me cope with stress	.46	.63	.48	.52	.47	.57
Helps me make new friends	.52	.62	.52	.55	.54	.58
Gives me more energy	.57	.16	.63	.20	.61	.17
Helps me keep in shape	.75	-.29	.76	-.34	.75	-.32
Makes me look better	.72	-.21	.73	-.26	.71	-.26
Helps me feel better about myself	.75	-.05	.78	-.10	.77	-.10
Makes me stronger	.75	-.18	.72	-.18	.74	-.14
Helps me be healthy	.72	-.36	.73	-.34	.73	-.35
Eigenvalue	3.83	1.12	3.96	1.11	3.97	1.10
% variance	42.57	12.49	44.02	12.34	44.06	12.24

Perceived barriers

Table A4.5: Factor loading for principal components analysis: PERCEIVED BARRIERS items among P7 pupils

	P7 boys (n=506)		P7 girls (n=549)		P7 all (n=1055)	
	Factor1	Factor2	Factor1	Factor2	Factor1	Factor2
I don't have enough time	.69	.20	.60	.05	.65	.18
It is difficult for me to get to places to do physical activities	.56	.43	.51	.64	.54	.50
I am not interested in physical activity	.63	-.52	.63	-.50	.63	-.51
I would rather do other things with my time	.73	-.29	.68	-.41	.71	-.32
I am not very good at physical activities	.71	-.26	.74	-.10	.72	-.23
I don't have the right equipment	.71	-.01	.65	.34	.68	.10
The weather is too bad	.55	.54	.58	.31	.56	.48
I feel embarrassed when I do physical activity	.67	-.22	.61	-.21	.64	-.26
I have too much homework to do	.55	.35	.59	.05	.56	.27
Eigenvalue	3.76	1.10	3.50	1.10	3.60	1.08
% variance	41.81	12.26	38.86	12.19	40.00	12.02

Table A4.6: Factor loading for principal components analysis: PERCEIVED BARRIERS items among S2 pupils

	S2 boys (n=510)	S2 girls (n=559)		S2 all (n=1069)	
		Factor1	Factor2	Factor1	Factor2
I don't have enough time	.74	.63	.27	.69	.19
It is difficult for me to get to places to do physical activities	.68	.56	.32	.62	.26
I am not interested in physical activity	.69	.69	-.41	.70	-.41
I would rather do other things with my time	.75	.74	-.22	.75	-.21
I am not very good at physical activities	.75	.74	-.33	.76	-.33
I don't have the right equipment	.75	.68	.10	.72	.08
The weather is too bad	.66	.66	.28	.65	.36
I feel embarrassed when I do physical activity	.70	.63	-.31	.67	-.30
I have too much homework to do	.55	.48	.60	.50	.61
Eigenvalue	4.39	3.80	1.04	4.13	1.02
% variance	48.73	42.27	11.57	45.85	11.37

Exercise self-efficacy

Table A4.7: Factor loading for principal components analysis: EXERCISE SELF EFFICACY items among P7 pupils

	P7 boys	P7 girls	P7 all
I could exercise even if.....	(n=502)	(n=544)	(n=1046)
I was tired	.57	.69	.64
I had other things I wanted to do	.69	.70	.70
I had to exercise on my own	.54	.64	.59
I had a bad day at school	.59	.68	.64
I was feeling lazy	.68	.73	.71
I was not very good at it	.55	.58	.56
I was sore from exercising the day before	.62	.63	.63
I was not in the mood	.72	.71	.71
Eigenvalue	3.11	3.60	3.36
% variance	38.90	45.03	42.01

Table A4.8: Factor loading for principal components analysis: EXERCISE SELF EFFICACY items among S2 pupils

I could exercise even if.....	S2 boys (n=513)		S2 girls (n=554)	S2 all (n=1067)
	Factor1	Factor2		
I was tired	.72	-.19	.67	.70
I had other things I wanted to do	.62	-.18	.75	.69
I had to exercise on my own	.56	.68	.66	.62
I had a bad day at school	.64	.45	.72	.70
I was feeling lazy	.71	-.34	.74	.73
I was not very good at it	.49	.28	.58	.54
I was sore from exercising the day before	.68	-.19	.71	.71
I was not in the mood	.70	-.26	.77	.74
Eigenvalue	3.33	1.03	3.95	3.72
% variance	41.58	12.89	49.32	46.54

Perceived competence

Table A4.9: Factor loading for principal components analysis: PERCEIVED SPORTS COMPETENCE items among P7 pupils

	P7 boys (n=517)	P7 girls (n=554)	P7 all (n=1071)
I can run fast	.70	.74	.73
I like to run and play hard	.62	.55	.62
I enjoy sports and games	.58	.57	.59
I have good muscles	.67	.67	.70
I am good at sports	.79	.84	.83
I can run a long way without stopping	.76	.77	.78
I am a good athlete	.80	.83	.82
I am good at throwing a ball	52	.39	.47
Eigenvalue	3.78	3.76	3.94
% variance	47.30	47.00	49.24

Table A4.10: Factor loading for principal components analysis: PERCEIVED SPORTS COMPETENCE items among S2 pupils

	S2 boys (n=517)	S2 girls (n=553)	S2 all (n=1070)
I can run fast	.73	.77	.77
I like to run and play hard	.74	.76	.79
I enjoy sports and games	.65	.67	.70
I have good muscles	.72	.66	.74
I am good at sports	.85	.86	.87
I can run a long way without stopping	.80	.78	.81
I am a good athlete	.86	.86	.87
I am good at throwing a ball	.58	.39	.51
Eigenvalue	4.45	4.30	4.67
% variance	55.67	53.78	58.34

Self esteem

Table A4.11: Factor loading for principal components analysis: SELF ESTEEM items among P7 pupils

	P7 boys (n=488)		P7 girls (n=519)		P7 all (n=1007)	
	Factor1	Factor2	Factor1	Factor2	Factor1	Factor2
I am pretty sure of myself	.51	-.35	.60	-.18	.57	-.26
I often wish I was somebody else	.49	.58	.66	.46	.59	.51
I am easy to like	.46	-.43	.54	-.43	.49	-.42
I have a low opinion of myself	.43	.57	.57	.50	.51	.53
I am a failure	.61	.40	.58	.42	.58	.42
There are a lot of things about myself I would like to change	.62	.49	.64	.44	.62	.47
I am able to do things well	.59	-.31	.55	-.45	.58	-.38
Most of the time I am satisfied with myself	.62	-.29	.72	-.26	.69	-.27
I like myself	.66	-.13	.76	-.16	.73	-.16
I feel I have a number of good qualities	.66	-.38	.69	-.30	.68	-.34
Eigenvalue	3.25	1.70	4.04	1.42	3.71	1.54
% variance	32.51	17.01	40.38	14.23	37.06	15.40

Table A4.12: Factor loading for principal components analysis: SELF ESTEEM items among S2 pupils

	S2 boys (n=491)		S2 girls (n=523)		S2 all (n=1014)	
	Factor1	Factor2	Factor1	Factor2	Factor1	Factor2
I am pretty sure of myself	.63	-.35	.72	.14	.70	-.23
I often wish I was somebody else	.60	.55	.66	-.51	.67	.49
I am easy to like	.57	-.40	.50	.28	.52	-.38
I have a low opinion of myself	.60	.51	.70	-.44	.66	.47
I am a failure	.61	.48	.74	-.15	.69	.32
There are a lot of things about myself I would like to change	.61	.54	.69	-.49	.68	.50
I am able to do things well	.67	-.37	.57	.59	.63	-.48
Most of the time I am satisfied with myself	.73	-.29	.78	.22	.77	-.25
I like myself	.79	-.20	.82	.08	.82	-.13
I feel I have a number of good qualities	.77	-.25	.75	.37	.77	-.30
Eigenvalue	4.39	1.69	4.87	1.35	4.85	1.41
% variance	43.90	16.86	48.67	13.51	48.48	14.06

Physical self worth

Table A4.13: Factor loading for principal components analysis: PHYSICAL SELF WORTH items among P7 pupils

	P7 boys (n=513)		P7 girls (n=551)		P7 all (n=1064)	
	Factor1	Factor2	Factor1	Factor2	Factor1	Factor2
I am happy with how I am and what I can do physically	.80	-.18	.83	-.22	.82	-.20
I feel confident about myself physically	.83	-.27	.83	-.17	.83	-.22
I don't have much to be proud of physically	.47	.73	.38	.84	.42	.79
I feel positive about myself physically	.77	-.28	.84	-.16	.82	-.22
I wish I could feel better about myself physically	.53	.66	.67	.43	.61	.56
I am very satisfied with myself physically	.77	-.15	.82	-.19	.81	-.18
Eigenvalue	3.02	1.18	3.56	1.04	3.24	1.09
% variance	50.29	19.59	55.91	17.30	53.92	18.19

Table A4.14: Factor loading for principal components analysis: PHYSICAL SELF WORTH items among S2 pupils

	S2 boys (n=506)		S2 girls (n=555)	S2 all (n=1061)	
	Factor1	Factor2		Factor1	Factor2
I am happy with how I am and what I can do physically	.86	-.21	.84	.86	-.26
I feel confident about myself physically	.90	-.18	.87	.89	-.23
I don't have much to be proud of physically	.42	.80	.57	.53	.75
I feel positive about myself physically	.85	-.22	.90	.89	-.20
I wish I could feel better about myself physically	.59	.64	.70	.69	.52
I am very satisfied with myself physically	.81	-.23	.86	.85	-.18
Eigenvalue	3.45	1.24	3.81	3.81	1.02
% variance	57.50	20.58	63.53	63.46	17.06

Paternal support

Table A4.15: Factor loading for principal components analysis: PATERNAL SUPPORT items among P7 pupils

How much does your father....	P7 boys (n=443)	P7 girls (n=499)	P7 all (n=942)
Encourage you to do physical activities	.75	.80	.78
Do physical activities with you	.79	.73	.77
Provide transport to places where you can do physical activity	.75	.72	.74
Watch you do physical activity	.85	.79	.82
Praise you for doing physical activity	.73	.78	.75
Eigenvalue	2.99	2.93	2.98
% variance	59.75	58.56	59.60

Table A4.16: Factor loading for principal components analysis: PATERNAL SUPPORT items among S2 pupils

How much does your father....	S2 boys (n=427)	S2 girls (n=473)	S2 all (n=900)
Encourage you to do physical activities	.82	.82	.83
Do physical activities with you	.75	.77	.77
Provide transport to places where you can do physical activity	.74	.75	.74
Watch you do physical activity	.86	.82	.84
Praise you for doing physical activity	.83	.84	.84
Eigenvalue	3.21	3.20	3.23
% variance	64.25	63.92	64.64

Maternal support

Table A4.17: Factor loading for principal components analysis: MATERNAL SUPPORT items among P7 pupils

How much does your mother….	P7 boys (n=479)	P7 girls (n=542)	P7 all (n=1021)
Encourage you to do physical activities	.71	.69	.70
Do physical activities with you	.65	.68	.66
Provide transport to places where you can do physical activity	.65	.70	.68
Watch you do physical activity	.79	.72	.75
Praise you for doing physical activity	.72	.71	.72
Eigenvalue	2.49	2.46	2.47
% variance	49.86	49.27	49.32

Table A4.18: Factor loading for principal components analysis: MATERNAL SUPPORT items among S2 pupils

How much does your mother….	S2 boys (n=467)	S2 girls (n=516)	S2 all (n=983)
Encourage you to do physical activities	.72	.72	.72
Do physical activities with you	.60	.70	.64
Provide transport to places where you can do physical activity	.72	.72	.72
Watch you do physical activity	.80	.80	.80
Praise you for doing physical activity	.78	.79	.78
Eigenvalue	2.64	2.79	2.70
% variance	52.85	55.72	54.01

Older sibling support

Table A4.19: Factor loading for principal components analysis: OLDER SIBLING SUPPORT items among P7 pupils

How much does your older brother or sister….	P7 boys (n=300)	P7 girls (n=303)	P7 all (n=603)
Encourage you to do physical activities	.85	.82	.84
Do physical activities with you	.84	.79	.82
Watch you do physical activity	.85	.84	.84
Praise you for doing physical activity	.83	.83	.82
Eigenvalue	2.83	2.69	2.76
% variance	70.70	67.23	69.03

Table A4.20: Factor loading for principal components analysis: OLDER SIBLING SUPPORT items among S2 pupils

How much does your older brother or sister....	S2 boys (n=286)	S2 girls (n=298)	S2 all (n=584)
Encourage you to do physical activities	.87	.86	.87
Do physical activities with you	.86	.85	.86
Watch you do physical activity	.87	.90	.89
Praise you for doing physical activity	.88	.85	.87
Eigenvalue	3.04	3.00	3.02
% variance	75.90	74.87	75.47

Perceptions of neighbourhood environment

Table A4.21: Factor loading for principal components analysis: PERCEPTIONS OF LOCAL NEIGHBOURHOOD items among P7 pupils

In the area where you live, are there...?	P7 boys (n=504)	P7 girls (n=537)	P7 all (n=1041)
Groups of young people who cause trouble	.78	.78	.78
Groups of adults who cause trouble	.76	.67	.72
Litter, broken glass or rubbish lying around	.73	.72	.72
Run-down houses or buildings	.68	.69	.69
Eigenvalue	2.18	2.04	2.12
% variance	54.45	50.98	53.10

Table A4.22: Factor loading for principal components analysis: PERCEPTIONS OF LOCAL NEIGHBOURHOOD items among S2 pupils

In the area where you live, are there...?	S2 boys (n=442)	S2 girls (n=504)	S2 all (n=946)
Groups of young people who cause trouble	.81	.83	.82
Groups of adults who cause trouble	.76	.72	.74
Litter, broken glass or rubbish lying around	.79	.77	.78
Run-down houses or buildings	.78	.77	.78
Eigenvalue	2.47	2.39	2.44
% variance	61.80	59.72	60.97

Appendix 5

Scale properties: internal reliability

Table 5.1: Internal reliability of PASS scales among P7 pupils

	No. items	Boys		Girls		All	
		n	Cronbach's α	n	Cronbach's α	n	Cronbach's α
Physical activity							
PAQ-C (short form)	5	458	0.77	525	0.82	983	0.80
Psychological							
Perceived competence	8	517	0.83	554	0.83	1071	0.85
Self-efficacy	8	502	0.78	544	0.82	1046	0.80
Perceived benefits	9	500	0.76	546	0.79	1046	0.78
Perceived barriers	9	506	0.82	549	0.80	1055	0.81
Physical self worth	6	513	0.76	551	0.82	1064	0.80
Self esteem	10	488	0.75	519	0.83	1007	0.80
Social							
Paternal support	5	443	0.83	499	0.82	942	0.83
Maternal support	5	479	0.74	542	0.79	1021	0.74
Older sibling support	4	300	0.86	303	0.84	603	0.85
Environmental							
Neighbourhood perceptions	4	504	0.72	537	0.68	1041	0.70

Table 5.2: Internal reliability of PASS scales among S2 pupils

	No. items	Boys		Girls		All	
		n	Cronbach's α	n	Cronbach's α	n	Cronbach's α
Physical activity							
PAQ-C (short form)	5	497	0.82	550	0.82	1047	0.84
Psychological							
Perceived competence	8	517	0.88	553	0.87	1070	0.90
Self-efficacy	8	513	0.80	554	0.85	1067	0.84
Perceived benefits	9	517	0.77	549	0.80	1066	0.79
Perceived barriers	9	510	0.86	559	0.83	1069	0.85
Physical self worth	6	506	0.81	555	0.88	1061	0.87
Self esteem	10	491	0.85	523	0.88	1014	0.88
Social							
Paternal support	5	427	0.86	473	0.86	900	0.86
Maternal support	5	467	0.77	516	0.80	983	0.78
Older sibling support	4	286	0.89	298	0.89	584	0.89
Environmental							
Neighbourhood perceptions	4	442	0.79	504	0.77	946	0.79

Appendix 6

Correlation matrices

Correlation matrices for variables in psychological models presented in Chapter 15

Correlation matrix for P7 BOYS psychological model

	PAQ-C	Perceived competence	Current intention	Benefits-barriers	Enjoyment	Self-efficacy
PAQ-C score	1.000					
Perceived competence	.483	1.000				
Current intention	.421	.450	1.000			
Benefits-barriers differential	.418	.472	.339	1.000		
Enjoyment	.354	.383	.261	.377	1.000	
Self-efficacy	.390	.493	.332	.468	.327	1.000

Correlation matrix for S2 BOYS psychological model

	PAQ-C	Current intention	Benefits-barriers	Self-efficacy	Perceived competence
PAQ-C score	1.000				
Current intention	.517	1.000			
Benefits-barriers differential	.454	.408	1.000		
Self-efficacy	.465	.458	.559	1.000	
Perceived competence	.426	.416	.571	.575	1.000

Correlation matrix for P7 GIRLS psychological model

	PAQ-C	Benefits-barriers	Perceived competence	Interaction benbar x competence	Current intention	Enjoyment
PAQ-C score	1.000					
Benefits-barriers differential	.461	1.000				
Perceived competence	.405	.528	1.000			
Interaction benbar x comp	.503	.962	.675	1.000		
Current intention	.406	.390	.354	.426	1.000	
Enjoyment	.335	.434	.429	.458	.290	1.000

Correlation matrix for S2 GIRLS psychological model				
	PAQ-C	Self-efficacy	Current intention	Enjoyment
PAQ-C score	1.000			
Self-efficacy	.450	1.000		
Current intention	.430	.433	1.000	
Enjoyment	.380	.472	.364	1.000

Correlation matrices for variables in social models presented in Chapter 16

Correlation matrix for P7 BOYS social model					
	PAQ-C	Peer socialising	Peer support	Family affluence	Paternal support
PAQ-C score	1.000				
Peer socialising	.399	1.000			
Peer support	.331	.233	1.000		
Family affluence	.141	-.034	-.006	1.000	
Paternal support	.175	.083	.184	.165	1.000

Correlation matrix for S2 BOYS social model				
	PAQ-C	Peer socialising	Peer support	Paternal support
PAQ-C score	1.000			
Peer socialising	.364	1.000		
Peer support	.328	.182	1.000	
Paternal support	.227	.048	.210	1.000

Correlation matrix for P7 GIRLS social model				
	PAQ-C	Maternal support	Peer socialising	Paternal support
PAQ-C score	1.000			
Maternal support	.265	1.000		
Peer socialising	.247	.048	1.000	
Paternal support	.221	.459	-.001	1.000

Correlation matrix for S2 GIRLS social model				
	PAQ-C	Peer support	Maternal support	Paternal support
PAQ-C score	1.000			
Peer support	.323	1.000		
Maternal support	.281	.313	1.000	
Paternal support	.233	.182	.470	1.000

Correlation matrices for variables in environmental models presented in Chapter 17

Correlation matrix for P7 BOYS environmental model			
	PAQ-C	Home equipment	Neighbourhood perceptions
PAQ-C score	1.000		
Home equipment	.281	1.000	
Neighbourhood perceptions	-.129	.068	1.000

Correlation matrix for S2 BOYS environmental model			
	PAQ-C	Access	Home equipment
PAQ-C score	1.000		
Access to local facilities	.186	1.000	
Home equipment	.183	.170	1.000

Correlation matrix for P7 GIRLS environmental model			
	PAQ-C	Availability	Home equipment
PAQ-C score	1.000		
Availability	.185	1.000	
Home equipment	.133	.153	1.000

Correlation matrix for S2 GIRLS environmental model			
	PAQ-C	Home equipment	Access
PAQ-C score	1.000		
Home equipment	.275	1.000	
Access	.182	.142	1.000

Correlation matrices for variables in integrative models presented in Chapter 18

Correlation matrix for P7 BOYS integrative model								
	PAQ-C	COMP	INT	EFF	ENJOY	SOCIAL	PEER	EQUIP
PAQ-C	1.000							
COMP	.488	1.000						
INT	.448	.470	1.000					
EFF	.360	.473	.321	1.000				
ENJOY	.342	.396	.269	.343	1.000			
SOCIAL	.415	.279	.195	.132	.138	1.000		
PEER	.333	.329	.224	.225	.197	.213	1.000	
EQUIP	.289	.300	.199	.138	.220	.204	.103	1.000

COMP=perceived competence, INT=intention, EFF=self-efficacy, ENJOY=enjoyment, SOCIAL=peer socializing, PEER=peer support, EQUIP=home equipment

Correlation matrix for S2 BOYS integrative model								
	PAQ-C	INT	BENBAR	EFF	SOCIAL	PEER	PATlow	PATnone
PAQ-C	1.000							
INT	.532	1.000						
BENBAR	.447	.440	1.000					
EFF	.454	.414	.538	1.000				
SOCIAL	.373	.312	.222	.173	1.000			
PEER	.316	.240	.377	.248	.193	1.000		
PATlow	-.192	-.107	-.158	-.146	-.078	-.239	1.000	
PATnone	-.115	-.053	-.176	-.098	-.003	-.080	-.195	1.000

INT=intention, BENBAR=perceived benefits-barriers differential, EFF=self-efficacy, SOCIAL=peer socializing, PEER=peer support, PATlow=paternal support (low), PATnone=paternal support (none)

Correlation matrix for P7 GIRLS integrative model

	PAQ-C	BENBAR	COMP	BBxCMP	INT	SOCIAL	MATlow	MATnone	AVAIL
PAQ-C	1.000								
BENBAR	.464	1.000							
COMP	.424	.540	1.000						
BBxCMP	.513	.965	.674	1.000					
INT	.411	.395	.370	.436	1.000				
SOCIAL	.260	.122	.237	.158	.102	1.000			
MATlow	-.269	-.304	-.299	-.323	-.151	-.074	1.000		
MATnone	-.030	-.035	-.043	-.035	-.027	-.012	-.096	1.000	
AVAIL	.188	.072	.149	.118	.053	.174	-.100	-.028	1.000

BENBAR=perceived benefits-barriers differential, COMP=perceived competence, BBxCMP=benefits-barriers x competence interaction term, INT=intention, SOCIAL=peer socializing, MATlow=maternal support (low), MATnone=maternal support (none), AVAIL=availability of local facilities

Correlation matrix for S2 GIRLS integrative model

	PAQ-C	EFF	INT	ENJOY	PEER	EQUIP
PAQ-C	1.000					
EFF	.455	1.000				
INT	.451	.428	1.000			
ENJOY	.387	.491	.373	1.000		
PEER	.322	.351	.234	.263	1.000	
EQUIP	.293	.223	.151	.171	.135	1.000

EFF=self-efficacy, INT=intention, ENJOY=enjoyment, PEER=peer support, EQUIP=home equipment

Appendix 7

Responses to individual scale items

Perceived benefits

Perceived barriers

Availability of local facilities

Access to local facilities

Neighbourhood perceptions

Home equipment

Perceived benefits

	P7			S2		
	Boys	Girls	All	Boys	Girls	All
Have fun						
Very true	75.4	70.1	72.6	77.3	43.8	59.9
Quite true	22.1	26.6	24.4	19.3	44.5	32.4
Not very true	1.9	2.3	2.1	2.7	9.0	5.9
Not at all true	0.6	1.1	0.8	0.8	2.6	1.7
Gender difference		*ns*			*p<0.001*	
Cope with stress						
Very true	32.1	23.0	27.4	25.2	18.9	22.0
Quite true	35.4	32.4	33.9	33.5	30.1	31.7
Not very true	21.1	28.2	24.8	22.2	35.2	28.9
Not at all true	11.4	16.4	14.0	19.1	15.8	17.4
Gender difference		*p<0.001*			*p<0.001*	
Make new friends						
Very true	42.4	33.8	37.9	39.0	22.6	30.5
Quite true	27.3	29.8	28.6	30.5	30.2	30.3
Not very true	18.2	20.6	19.4	19.3	29.9	24.8
Not at all true	12.0	15.9	14.0	11.2	17.3	14.4
Gender difference		*p<0.05*			*p<0.001*	
Have more energy						
Very true	66.8	65.6	66.2	62.8	51.1	56.8
Quite true	21.1	22.2	21.7	22.8	29.8	26.4
Not very true	8.8	8.5	8.7	10.2	12.9	11.6
Not at all true	3.3	3.7	3.5	4.2	6.2	5.2
Gender difference		*ns*			*p<0.01*	
Keep in shape						
Very true	77.2	71.3	74.1	73.1	64.0	68.3
Quite true	18.4	20.9	19.7	21.4	25.4	23.5
Not very true	3.3	5.4	4.3	3.8	8.5	6.2
Not at all true	1.2	2.5	1.9	1.7	2.1	1.9
Gender difference		*ns*			*p<0.01*	
Look better						
Very true	35.5	34.5	35.0	46.4	43.0	44.6
Quite true	30.7	34.0	32.9	29.6	27.8	28.7
Not very true	19.8	20.6	20.2	15.5	20.2	17.9
Not at all true	14.0	10.0	11.9	8.6	9.0	8.8
Gender difference		*ns*			*ns*	
Feel better						
Very true	59.5	58.0	58.7	64.0	53.8	58.7
Quite true	31.7	27.0	29.3	25.0	28.2	26.6
Not very true	6.2	10.5	8.4	7.4	12.5	10.1
Not at all true	2.7	4.4	3.6	3.6	5.5	4.6
Gender difference		*p<0.05*			*p<0.01*	
Get stronger						
Very true	70.8	59.3	64.8	71.3	46.5	58.4
Quite true	23.2	28.3	25.9	24.7	36.4	30.8
Not very true	2.9	8.2	5.6	2.9	13.0	8.1
Not at all true	3.1	4.3	3.7	1.1	4.0	2.7
Gender difference		*p<0.001*			*p<0.001*	
Be healthy						
Very true	81.3	81.9	81.6	77.9	70.8	74.2
Quite true	14.1	15.3	14.7	18.4	23.8	21.2
Not very true	3.4	1.2	2.3	3.0	4.0	3.6
Not at all true	1.1	1.6	1.4	0.6	1.4	1.0
Gender difference		*ns*			*p<0.05*	

Perceived barriers

	P7			S2		
	Boys	Girls	All	Boys	Girls	All
Lack of time						
Very true	7.7	6.4	7.0	6.9	5.3	6.0
Quite true	19.9	19.6	19.8	19.7	28.1	24.0
Not very true	33.7	41.1	37.5	36.1	41.9	39.1
Not at all true	38.7	32.9	35.7	37.4	24.7	30.8
Gender difference		*ns*			*p<0.001*	
Poor access to places						
Very true	8.2	10.5	9.4	10.3	9.2	9.7
Quite true	20.8	21.1	21.0	18.4	20.8	19.6
Not very true	27.5	30.0	28.8	27.4	39.8	33.9
Not at all true	43.5	38.4	40.8	43.9	30.3	36.8
Gender difference		*ns*			*p<0.001*	
Lack of interest						
Very true	3.7	4.3	4.0	4.6	6.2	5.4
Quite true	6.2	3.7	4.9	6.5	13.4	10.1
Not very true	15.6	19.4	17.5	16.6	30.2	23.7
Not at all true	74.6	72.6	73.6	72.3	50.2	60.8
Gender difference		*ns*			*p<0.001*	
Rather do other things						
Very true	9.3	6.2	7.7	8.2	12.3	10.3
Quite true	13.9	14.3	14.1	17.3	24.8	21.2
Not very true	31.3	40.5	36.1	31.8	38.3	35.2
Not at all true	45.5	39.0	42.1	42.7	24.6	33.3
Gender difference		*p<0.01*			*p<0.001*	
Lack of skill						
Very true	6.9	11.2	9.1	7.9	14.5	11.3
Quite true	15.5	20.3	18.0	14.0	25.1	19.8
Not very true	29.0	37.5	33.4	29.5	36.9	33.4
Not at all true	48.7	31.0	39.5	48.7	23.5	35.6
Gender difference		*p<0.001*			*p<0.001*	
Lack of equipment						
Very true	9.9	13.2	11.6	12.1	15.1	13.7
Quite true	19.7	23.3	21.5	16.3	29.5	23.2
Not very true	24.0	30.2	27.3	30.2	29.9	30.0
Not at all true	46.4	33.3	39.6	41.3	25.5	33.1
Gender difference		*p<0.001*			*p<0.001*	
Poor weather						
Very true	16.7	11.0	13.7	15.6	12.9	14.2
Quite true	25.9	24.3	25.0	25.4	29.9	27.7
Not very true	26.2	27.7	27.0	27.9	29.3	28.6
Not at all true	31.2	37.1	34.3	31.1	27.9	29.4
Gender difference		*p<0.05*			*ns*	
Feel embarrassed						
Very true	6.5	7.6	7.1	5.3	13.4	9.5
Quite true	7.6	12.4	10.1	11.5	19.5	15.7
Not very true	20.6	23.9	22.3	17.4	30.8	24.4
Not at all true	65.3	56.0	60.5	65.8	36.3	50.5
Gender difference		*p<0.01*			*p<0.001*	
Too much homework						
Very true	12.8	7.4	10.0	13.8	9.0	11.3
Quite true	14.7	10.8	12.7	22.6	22.0	22.3
Not very true	30.2	33.8	32.1	26.2	36.3	31.5
Not at all true	42.3	48.0	45.2	37.5	32.6	35.0
Gender difference		*p<0.01*			*p<0.01*	

Availability of facilities for sports and physical activity

(% pupils responding '*yes*' – facility is available within area in which they live)

	P7			S2		
	Boys	Girls	All	Boys	Girls	All
Sports centre	68.7	62.5	65.5	74.3	73.1	73.7
Playing field	91.7	83.4	87.4***	92.9	93.2	93.1
Swimming pool	60.4	55.7	57.9	65.4	61.0	63.1
Park	91.3	91.7	91.5	93.5	94.8	94.2
Basketball court	34.7	27.7	31.0	46.0	41.3	43.5
Tennis courts	48.9	39.8	44.2*	57.9	47.6	52.5**

Asterisks denote significant gender difference as follows: * $p<0.05$, ** $p<0.01$, ***$p<0.001$

Access to facilities for sports and physical activity

(% pupils reporting '*very easy*' or '*quite easy*' access within area in which they live)

	P7			S2		
	Boys	Girls	All	Boys	Girls	All
Sports centre	82.2	81.7	82.0	90.5	88.9	89.7
Playing field	94.5	86.7	90.5***	96.6	93.6	95.0*
Swimming pool	78.2	81.3	79.8	84.5	82.7	83.5
Park	95.4	95.6	95.5	97.2	96.4	96.7
Basketball court	43.3	39.6	41.1	57.6	52.1	54.7
Tennis courts	55.3	53.1	54.2	68.3	57.3	62.5***

Asterisks denote significant gender difference as follows: * $p<0.05$, ** $p<0.01$, ***$p<0.001$

Perceptions of local neighbourhood (% pupils)

		P7			S2	
	Boys	Girls	All	Boys	Girls	All
Litter, glass, rubbish etc						
A lot	31.6	25.7	28.5	28.5	23.1	25.6
Some	41.2	48.7	45.1	46.1	49.1	47.7
None	27.3	25.5	26.4	25.4	27.8	26.7
Gender difference		*$p<0.05$*			*ns*	
Run down houses etc						
A lot	9.9	5.2	7.4	12.4	8.6	10.4
Some	15.4	14.1	14.7	23.2	23.0	23.1
None	74.8	80.7	77.8	64.4	68.4	66.5
Gender difference		*$p<0.05$*			*ns*	
Youths causing trouble						
A lot	28.1	16.5	22.1	27.7	19.0	23.0
Some	45.4	53.2	49.4	53.1	57.3	55.3
None	26.5	30.3	28.5	19.2	23.8	21.7
Gender difference		*$p<0.001$*			*$p<0.01$*	
Adults causing trouble						
A lot	9.0	4.9	6.9	8.1	4.7	6.3
Some	26.7	22.3	24.5	31.4	28.5	29.9
None	64.2	72.7	68.6	60.5	66.8	63.9
Gender difference		*$p<0.01$*			*$p<0.05$*	

Asterisks denote significant gender difference as follows: * $p<0.05$, ** $p<0.01$, ***$p<0.001$

Availability of sports and games equipment within the home

(% pupils responding that they have equipment at home)

	P7			**S2**		
	Boys	Girls	All	Boys	Girls	All
Bicycle	88.8	91.4	90.2	83.7	88.6	86.3*
Sports balls	92.1	86.0	88.9**	86.0	86.7	86.4
Racquets	55.2	56.0	55.6	58.8	64.0	61.5*
Roller blades or skates	70.9	80.2	75.7***	56.3	72.6	64.8***
Skateboard	70.7	42.1	55.9***	53.3	41.2	47.0***
Skis or snowboard	11.3	4.9	8.0***	10.2	6.7	8.4*
Weights	42.5	26.5	34.2***	57.5	40.0	48.4***
Other	14.9	21.4	18.3**	10.6	14.7	12.7*

Asterisks denote significant gender difference as follows: * $p<0.05$, ** $p<0.01$, *** $p<0.001$